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Report of the

EXPERT CONSULTATION ON LARGE-SCALE PELAGIC DRIFTNET FISHING

Rome, Italy, 2-6 April 1990

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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PREPARATION OF THE PRESENT REPORT

This document is the final version of the Report approved by the Expert Consultation on Large-Scale Pelagic Driftnet Fishing convened by the Director-General at the Headquarters of the Food and Agriculture Organization in Rome from 2 to 6 April. It reflects the views of the experts which are not necessarily the views of FAO. The bibliographic references attached to the papers presented are as submitted by the authors.

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ABSTRACT

The Expert Consultation on Large-Scale Pelagic Driftnet Fishing was held at the FAO Headquarters in Rome from 2 to 6 April. It was informed of the discussion on the question which recently took place in a number of international fora. It assessed the status of technical and scientific knowledge with regard to (i) the data base, (ii) the diversity of driftnet fisheries, (iii) the fishing gear (iv) the fleet, (v) the problem of by-catches and discards, (vi) the socio-economic aspects, (vii) the potential for further expansion of the large-scale driftnet fishery, (viii) the spoilage of the catch and (ix) the ecological aspects. It reviewed the various options for management and made a number of recommendations with regard to catch and effort data, incidental catches, bio-economic fisheries interactions, the design of fishing gear, lost and discarded gear, navigational hazard, monitoring of the fleets, the reinforcement of regional management bodies, the convening of a special Governmental Consultation and the legal regime of high seas fishing.

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OPENING OF THE CONSULTATION

1. The Expert Consultation on Large-Scale Pelagic Driftnet Fishing took place in Rome at FAO Headquarters from 2 to 6 April 1990. It was attended by 12 experts. The list of participants is given in Appendix B.

2. Dr Armin Lindquist, Assistant Director-General (Fisheries Department) welcomed the experts on behalf of the Director-General. His opening statement is reproduced in Appendix D.

ELECTION OF OFFICERS

3. Mr Christopher Beeby was unanimously elected to chair the Consultation.

ADOPTION OF THE AGENDA

4. The Consultation adopted the agenda reproduced in Appendix A. The documents which were before it are listed in Appendix C.

ASSESSMENT OF THE PRESENT SITUATION

a) Summary of discussions on the question in various international fora

5. The Consultation noted that, although the issue of large-scale pelagic driftnet fishing was rather recent, it had been already discussed in an impressive number of international fora.

(i) United Nations System

6. On 21 December 1989, the General Assembly of the United Nations adopted a resolution (44/225) on large-scale pelagic driftnet fishing and its impact on the living marine resources of the world's oceans and seas. In view of its particular relevance to the work of the Consultation the full text of this resolution is appended as Appendix E to the present report.

7. A few weeks earlier the FAO Conference at its Twenty-fifth Session (Rome, 11-30 November 1989) discussed the matter in some detail. The relevant paragraph of the Conference's Report is also appended as Appendix F.

(ii) Pacific Ocean

8. In the North Pacific, Canada, Japan and the USA have had fruitful exchanges of views within the framework of the International North Pacific Fisheries Commission (INPFC) with regard to the squid driftnet fishery and its interaction with salmon fishing. The arrangements entered into in May 1989 by the three countries, providing inter alia for monitoring of the driftnet fishing fleets, were negotiated both "inside" and "outside" of INPFC. An observer programme was initiated in 1989 and a final report by all three INPFC member nations is expected to be presented at the October 1990 annual meeting of INPFC.

9. Beside the trilateral arrangements mentioned above it was noted that two other agreements on the same subject were concluded in 1989 in the region between the USA and the Republic of Korea and between the American Institute in Taiwan and the Coordination Council for North American Affairs.

10. In the South Pacific the South Pacific Forum adopted on 11 July 1989 the Tarawa Declaration which looked to a ban on driftnetting in the whole region and to the establishment of a regime for the management of albacore tuna in

the South Pacific. In October 1989 the Twenty-ninth South Pacific Conference considered the issue of pelagic drift gillnet fishing in the South Pacific Commission (SPC) region, called for an immediate ban of such fishing practices in this region and urged the SPC to continue to play its full role, in cooperation with other relevant regional bodies in the formulation of appropriate fishery management regimes. In November of the same year, a Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific was adopted by the countries and territories of the region and opened for signature in Wellington. When that Convention enters into force, the parties to it would be legally bound to prohibit their nationals and vessels from driftnetting anywhere in either 200 miles zones or the high seas within a defined Convention area. They would also be bound to prohibit the use of driftnets and the transshipment of driftnet catches within their 200 mile zones.

11. Recognizing the need for cooperation with other countries to achieve their objectives, the countries and territories of the region at the same meeting endorsed two draft protocols for that purpose. Draft Protocol I, open for signature by any State whose nationals or vessels fish within the Convention area, would bind parties to it to prohibit their nationals and vessels from driftnetting within the Convention Area. Draft Protocol II, open for signature by any state on or within the Pacific rim would bind parties to it to take the same action and, in addition, to prohibit the use of driftnets and the transshipment of driftnet catches within their own 200 mile zones. The draft protocols are to be discussed with countries eligible to sign with a view to their formal adoption later this year.

12. A second step had been the initiation of consultations with distant-water fishing nations including Canada, Japan, the Republic of Korea and the United States of America, on the establishment of a management regime for South Pacific albacore tuna. Although hampered by the non-attendance of Taiwanese interests (and the absence of any catch and effort data from Taiwanese vessels), good progress had been made in two rounds of consultations - in November 1989 and March 1990.

13. It was also noted that the Resolution of the General Assembly, will be brought to the attention of the Indo-Pacific Fisheries Commission (IPFC) which will hold its Twenty-third Session in May 1990 in Colombo (Sri Lanka).

(iii) Indian Ocean

14. The Consultation was informed that at its Ninth Session held in Mahé, Seychelles in October 1989, the Indian Ocean Fishery Commission (IOFC) discussed the matter. While acknowledging that poorly managed driftnet fisheries could present a serious hazard to living resources, the Commission felt that the real effect of driftnets on tuna stocks required a thorough scientific investigation in order to evaluate all possible implications. It requested that the effect of driftnetting on fish stocks be considered at the Eleventh Session of its Committee on the Management of Indian Ocean Tuna scheduled to take place in Bangkok in July 1990. The Secretariat informed the Consultation that a specific documentation was being prepared for submission to this meeting.

(iv) Atlantic Ocean

15. The development of driftnet fisheries was discussed at the 1989 annual meeting of the International Commission for the Conservation of Atlantic Tuna (ICCAT). Some members expressed concern about the use of this fishing

technique. Others stressed the danger of misunderstanding the use of this gear and stated that driftnet fishing can and should be managed as any other fishing gear on a scientific basis. It was agreed that the Scientific Committee should consider in its future deliberations the effects of driftnet fisheries.

16. On 24 November 1989 the Sixteenth Meeting of the Authority of the Organization of Eastern Caribbean States (OECS) adopted in Castries (St. Lucia) a Declaration in which it resolved (i) to seek to establish a regional regime for the regulation and management of the pelagic resources in the Lesser Antilles region that would outlaw the use of driftnets and other disruptive fishing methods and (ii) that all Member States of OECS will take all possible measures to prevent the use of indiscriminate fishing methods in their exclusive economic zones.

17. It was also reported that EEC was considering regulating this fishery in EEC waters and that two research programmes were presently being undertaken.

(v) Mediterranean

18. The Consultation was informed that a working group of the International Commission for the Scientific Exploration of the Mediterranean (ICSEM) met in Sète (France) in October 1989 and expressed concern about the growing number of Mediterranean cetaceans entangled in driftnets. The group urged governments to take the required measures and to promote research in this field.

19. It was also noted that at its Forty-eighth Session (Rome, 14-16 February 1990), the Executive Committee of the General Fisheries Council for the Mediterranean (GFCM) considered the possible role of GFCM in dealing with the problem of large-scale pelagic driftnets. The Executive Committee decided that the problem should be discussed at the Sixth Technical Consultation on Stock Assessment in the Balearic and Gulf of Lions Statistical Divisions (Casablanca, 28 May - 2 June 1990), then at the GFCM/ICCAT Expert Consultation on the Evaluation of Stocks of Large Pelagic Fishes in the Mediterranean (Bari, 21-27 June 1990). The matter should also be considered by the GFCM Committee on Fisheries Management at its First Session in 1991. This Committee should consider inter alia whether or not the moratorium recommended by the General Assembly should apply to the GFCM area and make appropriate recommendations to the Council.

(vi) Others

20. The attention of the Consultation was also drawn to the resolution on driftnet tuna fishing adopted in September 1989 in Versailles (France) by the ACP-EEC Joint Assembly urging all EEC and ACP Member States to ban driftnet tuna fishing in their own waters and to the Langkawi Declaration on Environment adopted in October 1989 in which the Commonwealth Heads of Goverments committed themselves to discourage and restrict non-sustainable fishing practices and to seek to ban tangle net and pelagic driftnet fishing.

b) Status of scientific and technical knowledge on the impact of large-scale pelagic driftnet fishing on living marine resources

21. Given the limited time available, the Consultation placed priority on documenting the characteristics of large-scale oceanic driftnet fisheries and, in particular, those characteristics of the gear and its impact on renewable resources that have become evident in the Pacific region, where this issue has

already been discussed for some time. It is hoped that this account will help define future research priorities and contribute to rational management of oceanic resources in other regions.

22. It was convenient to consider first the available information needed for assessment of currently targeted resources, the history of the fishery, and performance of the gear; and secondly, socio-economic and ecological considerations, including those relating to incidentally caught species and the priorities for future research that these imply.

(i) The data base

- Catch and effort data

23. Catch and effort reporting procedures in the pelagic driftnet fishery has been complicated by rapid and frequent redeployment of fishing effort between often widely separated fishing grounds and resources and, until recently, by fragmentary or slow reporting of the catch, effort exerted, and species taken. Although detailed statistics are now provided by Japanese fleets as agreed to under the terms of bilateral and multilateral agreements or commitments, for other fleets such as those from Taiwan (Province of China), detailed statistics are not collected. This situation, which was of great concern to the Consultation, makes it especially difficult to build up a consistent series of data and impossible to carry out accurate stock assessments. The specific needs for data for assessment of albacore stocks in the South Pacific, are given in Appendix G. In the South Pacific, the cooperative research networks (i.e. Scientific Advisory Group on Albacore) are expected to lead to a more extensive data exchange and greater coordination of research.

24. The standard way to collect catch and effort data is by log books but the only fleets routinely collecting such data on commercial species in the South Pacific (other than fleets within national waters) are the longline fleets. The US high-seas troll catches and, as from 1989/90, the Japanese pelagic driftnet catches are partly covered by reporting procedures. For the Taiwanese fishery, reporting is non-existent. Few of these reporting procedures document non-commercial by-catches or discards, and from experience the only procedure which has proved effective in determining the catch composition and the discard rate is an observer programme.

- Long-term trends in catch, effort, catch rate and abundance

25. Until very recently, existing fishing agreements did not specify adequately the type of data on incidental catches to be collected during fishing operations, and the absence of historical catch and effort data, catch rates, and species and sizes of fish caught in many of these fisheries, is still a main constraint on their assessment. This leads to a necessary but uncertain extrapolation from the available data in evaluating potential impacts of large-scale driftnetting by distant-water fishing fleets.

26. Data bases of catch and effort have become more available in recent years for the north Pacific driftnet fishery, from logbooks and from observer reports on a limited number of vessels, and this situation is soon likely to improve further. Information for earlier years of the fishery is less easily accessed. The catch data as currently available have serious deficiencies with respect both to by-catch (species captured incidentally), small and uncommercial fish discarded in the fishing process, and as "other losses" not showing up in the hauling of the gear. With reference to all driftnet fisheries there is a need for a coordinated effort to compile as complete a

historical information base as possible for these fisheries, by season and area of operation, in order to provide the historical series needed for analysis. Two papers providing some basic technical information are appended to this Report as Appendixes H and I.

27. Data on fishing effort and gear configuration (with hanging ratio) needs to be taken into account as well as set time and location, the number of kilometres of gear laid per vessel, and its seasonal distribution and effectiveness (fishing power). In order to make observations comparable between different driftnets, effort should ideally be expressed as km-days of net set, and catch rates as numbers or weight caught per km-day.

28. The Consultation noted that long-term catch data for the South Pacific fisheries since the fifties are available for longline catches of albacore by Asian and local fleets. Such data are also available for the North Pacific salmon driftnet fishery, and for the target species of the flying squid fishery from Japanese vessels. Comparable series of data on the distribution and intensity of effort by area and by season are scarce and generally fragmentary. The assumption that catch rate may prove a good index of abundance for oceanic species is a dangerous one, since catch rate and, hence fishing effort, is heaviest in areas such as along thermal discontinuities, where pelagic production and resources are concentrated. At present, however, few alternative indices of abundance have been developed, though observer counts of small mammals caught, if applied extensively, might provide one such index. For sea birds and seals, counts of numbers in rookeries may also provide independent evidence of population trends but the various data sources need to be compiled in a systematic way.

29. The main requirement for future evaluation of these fisheries is that catch and effort by species, including non-target species, be compiled for longline and surface fisheries stratified by not larger than 5 degree squares of Latitude/Longitude, and by month. The Consultation noted that this requirement should be made a global one for all distant-water fisheries, since similar interactions between distant-water and coastal fisheries occur throughout the world, given that most high seas stocks are transboundary with adjacent exclusive economic zones. The current absence of this kind of data makes it very difficult to evaluate resources.

30. In addition, the difficulty of arriving at the complete set of catch, effort and biological data needed to carry out assessments on a stock-by-stock basis has always required integration of coastal and distant-water data. Problems in respect to obtaining distant-water data have often occurred, but, despite the recent full cooperation of some distant-water fishing countries, problems are still significant due to the unpredictable changes in fleet deployment on a global basis in response to market demand and resource availability.

31. The Consultation noted with interest data provided by a major tuna processing company which allows informal estimation of the world catch of albacore by main gear type, data which are not readily available through FAO statistics. The latter do not distinguish species adequately in the processed product.

32. The Consultation recognized that although assessments should preferably be performed by regional organizations, reporting and integration of distant-water fishing data, especially for catches and effort within international waters for transboundary stocks with adjacent EEZs, should be integrated globally. The Secretariat explained the difficulties encountered with poor

reporting of fisheries effort data through the STATLANT B forms distributed to member countries. Considerably greater resources and national cooperation would be needed to provide such a reporting system in close to real time, with adequate breakdown of data by gear, time and area categories, together with the capability to organize and implement field control of data quality. Such a function goes far beyond the resources available to the Fisheries Department of FAO, which is already facing difficulties in maintaining quality control on national reporting of catch data by major species.

33. The Consultation, nonetheless, thought it desirable to evaluate the feasibility and financial implications of setting up such a central data collection and storage facility. The data collected would be made available on an annual basis to regional bodies. This, of course, does not supplant the requirement for direct reporting of specific data by distant-water fishing nations implied by their membership of specific regional fisheries management bodies.

- Biological data

34. Information on the southern and northern albacore stocks still needs to be refined with respect to growth, mortality, recruitment, seasonality of spawning and stock structure, and the spatial and seasonal migration patterns and distribution of this species in relation to oceanographic features. Our biological knowledge with respect to key by-catch species in driftnet and long line fisheries such as pomfret, sharks, billfish, the various squid species taken, and small cetaceans, is even more fragmentary, and the Consultation favoured an accelerated programme to assemble data on these species, plus provision by fishery nations of more detailed information on fleet operations. An attempt to determine sustainable rates of removal of the main species concerned, and to look at the interactions between different gears and species, are priorities.

35. Tagging studies will be required to document stock structure, migration, mortality rates and interaction between fisheries, for the main resources.

(ii) The diversity of driftnet fisheries

36. The Consultation reviewed some major gillnet and driftnet fisheries, in order to obtain a good perspective on the scope of the problem. The following fisheries were discussed:

- Inshore artisanal fisheries have operated in many coastal zones of the world for many centuries. A wide variety of gillnets and set or entangling nets, fishing for pelagics on the surface, and demersals and crustaceans/cephalopods close to the bottom, are currently used inshore. Gear dimensions typically have not exceeded several hundred metres per boat. In general, the fisheries in question have proved to be sustainable, although more attention should be given to defining incidental catches.

- The Japanese high-seas salmon driftnet fishery is regulated through negotiation within the International North Pacific Fisheries Commission and bilaterally between Japan and the Soviet Union. The total all-nation landings of approximately 800 000 t of all species of salmon in recent years, are at the historic high levels of catch that occurred from 1927 to 33, indicating that, in general, salmon stocks are healthy.

- The squid driftnet fishery started in the late seventies near Japan, following the decline of the Todarodes jigging fishery and later extended to offshore waters. A northerly limit for this fishery has been established to avoid major by-catch of salmon. It is reported, however, that significant catches of these fish by some Asian driftnets have been entering markets in Southeast Asia, but more investigation on this point is needed.

- The large-mesh driftnet fishery, initiated in the North Pacific in the mid-seventies and in the South Pacific from the mid-eighties, with 459 boats of 100-500 GRT, targets the albacore stocks. At least since the 1989/90 season, catch reporting has been compulsory for Japanese boats. About 43 boats from Japan and from Taiwan (Province of China) are believed to be operating in the South Pacific in the 1989-90 season. There is also a Taiwanese large-mesh driftnet fishery for albacore in the Indian Ocean.

- A new driftnet fishery for albacore by French vessels has operated in the Bay of Biscay since 1986.

- A significant large-mesh fishery for swordfish and albacore is operated in the Central Mediterranean by a large Italian fleet.

37. Pelagic driftnet fisheries have also been operating in other areas: thus, Japanese vessels have operated in the Tasman Sea for several years and Taiwanese driftnet vessels operated in the Arafura and Timor Seas north of Australia for shark, mackerel and longtail tuna from 1974 until 1986, when the fishery was terminated due to what was perceived by the Australian Government to be an unacceptably high dolphin by-catch. That fishery continues in waters north of the Australian fishing zone. Driftnets are also used offshore from Greenland for salmon, for mackerel in the Northeast Atlantic, and more recently, in the Bay of Biscay by France for albacore. Smaller scale driftnet fisheries also exist in the Indian Ocean and elsewhere but the Consultation did not direct its attention to these.

38. In general, all offshore types of driftnet can be operated from a variety of types of vessel, and switching between gears or target species does not involve major refits. Recently, vessels in the pelagic driftnet fleets have included multi-purpose boats using at least two gear types. A fairly high proportion of vessels, particularly in the fleet of Taiwan (Province of China) are old, converted from other fisheries. Displacement of vessels from some foreign EEZs and existing driftnet fisheries, as well as market influences, appear to have contributed to the increased driftnet effort in other areas, including the South Pacific and Indian Ocean.

39. The internationally accepted definition for driftnet is a type of gillnet. With this type of gear, fish are gilled, entangled or enmeshed in the netting. A driftnet is kept on the surface or a certain distance below it, by numerous floats, drifting freely with the current (FAO Tech. Pap., 222). Gillnets have been used inshore for centuries around the world. Large-scale driftnets can entangle large fish because they are loosely hung and neutrally buoyant. This type of gear in consequence is less selective by species than gillnets proper.

(iii) Information on fishing gear

- Preliminary gear trials

40. A small number of experiments have been reported which suggest that incidental catches of marine mammals and birds may be reduced to different extents by setting large-scale driftnets below the surface layers. An almost total absence of bird and mammal by-catch was reported by Japanese scientists in the Tasman Sea in a relatively small-scale experiment with a setting depth of 2 m and a rather less convincing decline in waters off northern Australia with a 4.5 m fishing depth. In this latter case, by-catch was reduced by some 50 percent, but target catch also by some 25 percent, with some entanglements occurring as deep as 10 m. French experts experimented at a depth of 5 m below the surface with a total absence of birds and mammals. Further cooperative experiments could be carried out, including other areas and seasons under controlled conditions and wherever driftnet fisheries are being contemplated. Experiments with acoustic modifications have been unsuccessful in reducing cetacean by-catch in driftnets.

- Comparison of gears and fisheries

41. The French fishery for albacore with large-scale surface driftnets in the Bay of Biscay was initiated in the context of a declining fishery with other types of gear. This fishery takes the same size distribution of catch as for other surface gears, except pair pelagic trawling. The opinion of many French experts is that in circumstances where the stock is dispersed or already heavily exploited, no alternative method of exploitation has yet been developed which provides an acceptable economic return to fishermen. An analysis of interactions with the other albacore fishery showed that the driftnet fishery, which represents a small percentage of the total landings, has a minor impact on the resource and on the competing gears because the effort is low. At least in temperate colder waters, no significant quality problems have been reported for this fishery, other than those involving handling and freezing of the catch, which are being solved. Licensing and logbook compilation are compulsory in this fishery.

42. The experience reported in the South Pacific fishery in this regard is different, with catch-per-day figures being more closely comparable between troll and surface gillnet fisheries, of 2-7 t/day, and 2-8 t/day, respectively. This similarity may, however, be a function of the higher fish density in this area.

43. Canadian reports of a new jigging fishery this year for flying squid in British Columbia waters were mentioned, as a possible long-term alternative to driftnetting. The results still remain to be evaluated in terms of feasibility and economic performance. Earlier Japanese experience, however, suggests lower rates of return with this gear in the North Pacific and significant losses due to jig damage to squid caused by the large size of individual squid.

- Gear interactions and ghost fishing

44. Physical gear interactions have been reported in the South Pacific between driftnet and troll fisheries. However, interactions may result both from competition for the same younger age groups of tuna, with the surface fisheries and the impacts of surface fisheries on catches of older fish later in long-line fisheries. In the latter case, it is recognized that the maximum

sustainable yield (MSY) for combined surface and longline fisheries is estimated to be larger than for a longline fishery alone.

45. Problems of ghost fishing by lost or discarded sections of net are of considerable concern because of potential entanglement of marine mammals, birds, and fish. Although it would be technically feasible to estimate this impact, little information is available on the rate of loss or wear of driftnets, the proportion of discarded nets and the size and fate of pieces of lost nets or their actual "fishing efficiency".

(iv) The fleets

46. The number of vessels which have been deployed in the high-seas fishery of the South Pacific is difficult to quantify. Currently, the indications are that the Taiwanese fleet consists of 24 driftnetters and the Japanese fleet 20. Korean vessels are not engaged in commercial driftnetting in the region in the 1989/90 season. In previous years since 1985, many more vessels were involved in the driftnet fishery, with the Taiwanese fleet alone consisting of more than 150 vessels at one stage. The ages of these vessels range from less than 5 years to over 25 years. No accurate data are available regarding the displaced vessels although there is an indication that some have moved to the Indian Ocean. Appendix J summarizes the available information in this respect.

47. In the Bay of Biscay, a dramatic decline was noted from a high in 1966 when a total of 566 trolling and pole and line vessels were engaged in the albacore fishery with a total catch of 40 300 t to only 37 driftnetters and 35 pairs of trawlers in 1989 with a total catch in the order of 4 000 t. The current fleet is fairly modern.

- Inshore and off-shore driftnet fisheries

48. The Consultation commented on the distinction made between small gillnets as used in nearshore waters by artisanal fishermen, and large-scale offshore driftnets. The difference seems largely one of degree, many small nets being equivalent to one set of a very large net. In many countries, regulations ban or restrict the use of this type of gear. It was suggested that the use of this kind of passive gear within EEZs, especially in narrow straits, may have serious impacts on migratory target species, with high mammal and bird by-catch. There is some limited evidence however, that there is more likelihood of the incidental catch of rare species offshore.

- Distant-water fishing strategies and reporting

49. The Consultation discussed licensing procedures by national authorities of distant-water fishing countries, which often allocate a licence to their nationals to operate in fishing areas outside their own EEZs. It was agreed that there are serious problems in determining whether such allocations are respected. The use of vessel transponders monitored by satellites would improve the situation, although greater transparency between fishing country and regional or national management authorities, in communicating the names of vessels licensed to fish would assist greatly in detecting infringements to these internal licensing procedures. Such two-way systems of reporting are in effect in the North Pacific and have greatly improved the climate for cooperative sustained resource management.

(v) By-catches and discards

50. These can be divided into four components:

(A) Commercially-important species which are landed in poor condition or discarded, perhaps due to long soak time or damage by predators.

(B) Actually or potentially commercial species which are not landed in large amounts, such as salmon, pomfret, sharks, and some less commercially acceptable species of squid, and species which are not yet of commercial importance, but could eventually be the object of a fishery, or are the object of harvest elsewhere.

(C) Species without commercial importance, which may be important as members of the oceanic ecosystem, or valued for other reasons. Here are often included dolphins, small whales, fur seals and birds.

(D) Rare species, or species whose exploitation is the subject of specific international regulations (some of these overlap with the previous category).

51. Referring to the first three of these categories, the state of information can be briefly summarized as follows:

52. Category (A): our information is moderate to poor: observer reports suggest that the damaged or spoiled proportion of the target catch may be significant; and probably is higher in tropical waters after soak times in surface waters of up to 14 hours at 20°C or more. Originally, reports of prices received for driftnet fish were roughly 60 percent of those received for catches from other surface gear, suggesting fish quality was not uniformly high, although as noted later, this differential has now narrowed considerably.

53. In other cases such as southern albacore, observations of driftnet damage (net-marked) on fish caught later by trolling or longline, have averaged 25-30 percent in areas where large-scale driftnets have operated. This provides evidence, both for a high interception by driftnets, for a less than complete retention rate by that gear, and for damage to escaping fish. Certainly, a significant proportion of undetected mortality due to predation while on the net, or subsequent to injury, must also occur with this type of gear, in addition to the amount of dead fish which drops out of the net. This type of observation needs to be extended, and supports also the likelihood of direct gear competition between surface gears for smaller fish, and for sequential impacts on larger, deeper-swimming albacore, caught later at larger sizes by longline.

54. Category (B): The discard rate of potentially commercial species can be very high, e.g., for pomfret; almost complete discarding of over 100 000 t per year has been noted in the North Pacific in the flying squid gillnet fishery.

55. The by-catch of important non-target commercial species in the North Pacific varies greatly with season, area and water temperature. Thus, tunas predominate in water temperatures over 15°C; squid at around 13°C, especially near thermoclines, and salmon in waters below 13°C. Seasonal overlaps may occur however: even if rarely in meandering areas of the North Pacific, squid driftnets are more likely to intercept salmon in July-August when migratory ranges tend to overlap, and accidental annual by-catches that may have reached 3 000 t of salmon in the driftnet fishery are calculated to occur, according to Canadian experts. The reported large numbers of salmon (possibly 40 000 t) that entered Southeast Asian markets several years ago, probably were taken in driftnets by a directed fishery by Taiwanese vessels. The Consultation was informed that, according to a scientific survey executed by the Republic of Korea in the North Pacific squid fishery, the by-catch was extremely low (13

salmon, two birds and no mammals). According to this report the distribution of maispecies does not overlap because of their differing temperature and salinity tolerance and, as a consequence, no impact on non-target species has been found.

56. Category (C): Considerable public concern continues to be shown at the prospect of continuing high catch numbers of incidentally-caught marine mammals, turtles and birds. At least one Fishery Commission, namely the Inter-American Tropical Tuna Commission has attempted to regulate dolphin and porpoise by-catch in the purse-seine fishery. In several cases, such considerations are enshrined in regulations or proclamations, notably in the Convention establishing Commission for the Conservation of Antarctic Marine Living Resources.

57. Cetacean by-catches have been recorded in all large-scale driftnet fisheries where scientific observers have worked, except in the case of a Korean research cruise in the North Pacific squid fishery in 1989. In addition to marine mammals, thirteen species of seabird have been observed to be captured incidentally in the driftnet fishery for flying squid; the most common species being shearwaters. Again although unambiguous estimates of impact cannot be provided, a large number of birds are caught annually. It is far from clear whether such levels are sustainable or not by the bird populations concerned. Far more work needs to be done both to refine these figures and to determine what impacts the removals have on the demography of the species concerned.

58. Such limited observer data as are available certainly suggest that the cumulative numbers of small marine mammals taken in surface driftnets in a year can be large, although estimates of population sizes are generally lacking to allow impact evaluation. Very preliminary estimates by Canadian scientists suggest that of the order of less than one percent of one small cetacean population may be taken in the North Pacific squid driftnet fishery. Japanese experts found little impact of the salmon and squid gillnet fisheries on the catch rate of Dall's porpoise but a population decline of the Pribilof fur seal population to 0.8 million from double this in the fifties, has been attributed by some sources to entanglement and ghost fishing of lost nets; it could also be partly due to other environmental changes, since this decline is reported to have begun in the seventies before the squid driftnet fishery began, although the salmon driftnet fishery has been conducted since 1952.

59. In the case of waters off the Arafura and Timor Seas in the Australian fishing zone, an apparent decline in cetacean by-catch was detected over several years of the fishery by regression analysis, which is one of the few documented rates of decline of incidentally-caught cetaceans available. Analysis of trends in cetacean catch rates for later years of the fishery was hampered by rapid changes in gear configuration effort levels and areas of operation. Over the period 1981-85, an average of 0.81 cetaceans per set were estimated to have been captured, with estimated removals being as high as 580 cetaceans per 1 degree block on longitude and latitude per year.

(vi) Socio-economic aspects

60. These may be divided into two categories:

- The actual or potential impact of the driftnet fishery by distant-water fleets on local resources:

61. It was the sharp rise in unregulated exploitation rate in 1988-89 within

the South Pacific, roughly doubling catches of albacore tuna in one year, which led to concern as to its potential impact on the stocks and the livelihoods of small island nations. This, together with the incidental catch of other non-target species noted by coastal state observers, prompted the ban on this type of gear following the Tarawa Declaration in 1989. As yet, no evaluation has been made of the impact of this fishery on the southern albacore stocks.

62. In several cases it appears highly probable that interception of young fish in surface driftnets, if unrestricted, will have quantitative repercussions on captures of older fish in other gear or, in the case of billfish and swordfish, may lead to impacts on locally important sport fisheries. At the same time, experience elsewhere suggested that an appropriate combination of surface and longline efforts for tunas, can increase sustainable yield.

63. The impact on local land-based operations of a mobile fleet fishing in such a way as to cause local depletion, includes loss of development opportunities and impact on local fisheries, markets and canneries is of concern. In the case of fisheries within EEZs of small island States, depletion can also cause loss of important revenues from licensing or joint-ventures.

- The impact of fishery closures on the livelihood of distant water fishermen and fishing enterprises

64. Information available suggests that the vessels engaged in the driftnet fishery in the South Pacific were adapted from longline vessels previously used to fish flying squid and other resources in the North Pacific and elsewhere. These offshore squid fisheries, in turn, were a technological response to declining abundance of Todarodes squid and to high market demand for squid in the Northwest Pacific rim countries, unsatisfied by local resources. Few of the vessels are new and, particularly for the Taiwanese fishery, were often adapted to driftnetting after a long life in other fisheries.

65. The wish to find year-round employment for distant-water fishermen was probably one factor that led to the development of the South Pacific driftnet fishery, particularly in the light of progressive difficulties in recent years in access by distant-water fleets to foreign EEZs in the North Pacific. Changes in catch rates for squid, and in market prices due to increased supplies elsewhere, (notably the Southwest Atlantic) also cannot be discounted with respect to their effect on world prices. Without further detailed information on the considerations used for strategic planning and deployment of distant-water fleets, not at present available, it is difficult to be specific as to socio-economic impacts in this sector. Low catch rates in conjunction with continued fishing suggest that reducing losses by maintaining vessels crewed and operating, even if temporarily unprofitable, may sometimes be an economically motivating factor. It may be noted that the pelagic driftnet fishery is supporting a very significant on-shore employment, especially in the tuna canning industry.

66. According to Japanese sources, the cessation of foreign vessel allocations to Japan within US waters in 1988 was the major cause of fleet displacement to the South Pacific the following year. The favourable opportunities found there during fishing trials may also have led to an expansion of the driftnet fleet, formerly concentrated in the Tasman Sea.

(vii) The potential for further expansion of the large-scale driftnet fishery

67. The potential impact of local regulation and/or resource depletion in one area on resources and fisheries elsewhere, was of particular concern to the Consultation: in particular, the effect of fishing effort displacement from a given fishing area to new fisheries which up to now have not received high fishing effort. Several possibilities of this were mentioned and their potential effects; for example, a driftnet fishery in the Indian Ocean would have potentially high impact on the juveniles of the southern bluefin stock, which occur in that area. Oceanic squid fisheries are common throughout the world oceans, especially along boundaries of water masses, including the Southern Ocean. The potential diversification of large-scale driftnet fishing to sub-Antarctic areas (where squid jigging trials have already been conducted) without prior impact evaluation, is already of concern to CCAMLR.

(viii) Spoilage of the catch; handling, processing and profit margins

68. In addition to known and undetected drop-out losses of fish prior to and during hauling of the net and predation on fish in the nets, a significant proportion of fish caught in driftnets are reported to be discarded. There seems to be evidence that deck handling and icing procedures have improved the quality of driftnet-caught fish in recent years. At the same time, the considerable price differential between driftnet catches and catches from other fishing methods has dropped in recent years, in response to improved handling and improved methods of dealing with blood spots on spoiled fish. There seems evidence that the category 'driftnet fish' is now frequently applied to lower quality fish from whatever source. There is also little evidence at present that existing grades of tuna necessarily correspond to division between harvesting methods and, in fact, given that a price differential still exists, the economic incentive for canneries to purchase driftnet caught fish, given improved methods of treating the fish, is obviously high. Fish quality is evidently not the disincentive it was previously thought to be, since profit margins to the processing industry are apparently greater in many areas with fish taken in driftnets than for other methods.

(ix) The impact assessment

- The ecological impact and conservation

69. At present, the data to carry out thorough impact assessment of most driftnet fisheries has not been forthcoming, although preliminary information gives reason for caution in the conduct of such fisheries. In some cases, as in the North Pacific, the albacore fishery continued from the mid-seventies until the late eighties by long-line and trolling without the estimated MSY for albacore of 86 000 - 136 000 t being exceeded. In 1989, however, declining catch rates, low abundance of age 3-4 fish and other information, raised concerns that a large number of juveniles were being intercepted by the flying squid driftnet fishery. Canadian estimates suggested that these interceptions could be taking up to 40 percent of the directed catch. Other opinions suggested that the same factors that could have resulted in highs in the salmon and pollack fisheries of the North Pacific, that is, climatic effects of the El Niño type, may be the causal factors. To some extent however, the first of these hypotheses may be explored by placing observers on board vessels fishing for flying squid to observe by-catch, as is intended in 1990.

70. Considerable concern has been shown in 1989-90 in the Mediterranean on the impact of the growing use of large-scale driftnets for swordfish.

Information suggesting high catches of 0-group swordfish by a variety of gears, both in the central and eastern Mediterranean and in the Carribbean by longline, suggest that this species may be especially vulnerable to local overfishing. Concern has also been expressed on impact on cetacean populations which are thought to be caught in very large numbers by the Italian swordfish fishery.

71. Limited information based on direct underwater observation in the Tasman Sea has provided new evidence as to the numbers of cetacean by-catch entangled in large-scale driftnets. These estimates are roughly comparable with similar estimates from elsewhere. Expressed for comparative purposes, in numbers of marine mammals per 10 km of driftnets these estimates are as follows:

- Arafura/Timor Sea fishery for shark and mackerel:

  0.56 cetacean/10 km of driftnet per day

- Tasman Sea albacore fishery:

  0.64 cetacean/10 km of driftnet per day

- North Pacific tuna driftnet fishery:

  0.58 cetacean/10 km of driftnet per day

- North Pacific driftnet fishery for flying squid:

  0.37 cetacean/10 km of driftnet per day

72. The total numbers of marine mammals and birds killed incidentally can only be estimated roughly but numbers of interceptions extrapolated from observer data suggest for the North Pacific squid fisheries, that numbers of marine mammals killed incidentally are in the order of hundreds to around 50 000 individuals per year, depending on species involved; and similarly, high numbers have been taken in some of the tropical driftnet fisheries. Just what these numbers correspond to in terms of the total population is not clear, although some isolated rough estimates were mentioned earlier in the report.

- Multispecies considerations and ecological impacts

73. It was agreed that, although the relative abundance of species under exploitation will inevitably differ from that applying under unexploited conditions, the conservation of all components of the ecosystem is an important consideration. This is not only because we know little of the role of each species in the ecosystem, but it is thought to be important in preserving stability of the system itself. Retaining options can also be considered, given that there may be future changes in the perception of the relative value of individual resources.

74. It was further noted that in the case of multiple species being caught by an unselective gear, the rate of harvest must be restricted to that rate which allows populations of the slowest growing and reproducing species to survive. This will be lower than the allowable catch possible on some commercially valuable components with gear adapted to single species capture. The Consultation stressed the need for developing more selective gear or modifying or deploying existing gear in areas and times so that excessive by-catch levels be avoided.

75. It was also stressed by the Consultation that ways be sought to retain economically viable by-catches where possible for human consumption.

76. Although the Consultation was unanimous in agreeing that evaluating and quantifying potential impacts of the large-scale driftnet fishery on the oceanic ecosystem and its components is of major concern, it was also clear that such an analysis would require a major research effort over a number of years and full collaboration of the fishing industries involved. It will be years before adequate data have been collected to support a realistic model of oceanic systems even should adequate funding be immediately provided for research. Such an eventual model should consider the trophic relationships between components of the system, which are still almost unknown, and would certainly also need to consider oceanographic considerations.

77. Although such an exercise is considered a high priority, the Consultation recognized that the short time needed to introduce a new technical development to improve yields or to extend a fishery to new areas and resources, with rapid deployment of a high fishing intensity, contrasts unfavourably with the much longer time needed to set up data collecting systems, study fishery impacts, and introduce an agreed framework for management of the resource.

78. Comprehensive impact assessments of human activities, including fishing, upon marine ecosystems should be made on an interdisciplinary basis. For that purpose, research activities should be strengthened at the local, regional and global level and in full collaboration with the fishing industry.

REVIEW OF MANAGEMENT OPTIONS

79. The Consultation agreed that the basic principles for management of large-scale driftnet fisheries should be compatible with the provisions of the 1982 UN Convention on the Law of the Sea (UNCLOS), the General Assembly Resolution 44/225, and that the objectives should include the long-term sustainability of the resources affected.

80. The main fisheries involving large scale driftnets are the albacore fisheries in the North Pacific, South Pacific, and Indian Oceans, the squid fishery in the North Pacific, and salmon fisheries in the North Pacific and North Atlantic. Driftnet fisheries exist in many other areas such as in the Bay of Biscay, in the Mediterranean, off Sri Lanka and Pakistan and in the Arafura Sea. Off northwestern Australia there was, also in the past, a fishery targeted on tropical sharks. The Consultation focused discussions on the larger-scale fisheries while recognizing the need for more information on the others and the potential usefulness of the accumulated management experience.

81. Management objectives requiring attention include sustained development within the natural constraints of the oceanic ecosystem (in both the short and long term), optimal sustained utilization of target and non-target species, orderly development of the fishing industry, reduction of the uncertainty for both industry and the resource, reduction of interaction with other fisheries, safety of navigation and minimum international conflict. Other specific objectives of management in driftnet fisheries include reduction of "ghost fishing", minimizing the risk of over-capacity. It was noted that some of these objectives might be conflicting.

a) Constraints and issues

82. The data available are generally inadequate to make management decisions with confidence, and this is both a cause for concern and a serious limitation on collaboration and proper assessment. Available catch and effort data by species, time period and area are incomplete and may be inaccurate. Some data exist at national level, with fisheries agencies or industry, which are not being provided, even to national scientists. The Consultation noted that detailed trade statistics should be more frequently sought from industry to use to assist in management decision. Biological parameters for target and non-target species as well as fishery-related parameters (age and origin of vessels, drop-out rate, economic data on distant-water nations fisheries, etc.) may be available from these sources to supplement other source of data.

83. The standard stock-assessment methodology might need some innovation. Significant improvements of knowledge on target and, above all, non-target species taken in high-seas fisheries will take considerable time, and the consequences of the resulting uncertainty will have to be taken into account in the decision-making process. Research may provide, at this stage, only a qualitative understanding of the situation. With additional effort, some quantitative understanding is possible but the development of an effective predictive ability (including appropriate multispecies and management models) will be not only time consuming, but may fall short of definitive results.

84. The Consultation believed that it would be unwise to wait for definitive data to become available and that action should be taken on the best available information.

85. It was recognized that the objective of sustainable development of fisheries within the natural constraints of the ecosystem implied that the fisheries should be managed from an ecosystem perspective and that a much greater understanding of the oceanic environment would be required to achieve such a goal. Although most experts agreed with the desirability of an ecosystem management objective, it was pointed out that, in practice, there is great difficulty in obtaining the enormous amount of data and analysis necessary. It was also mentioned that sustainable development implied sustainable use and that management should attempt to ensure that no species should be severely reduced with the possibility of threatening its existence. Management of large-scale oceanic ecosystems must therefore take into account the uncertainty resulting from the complexity of the system and the cost of obtaining the information. Procedures should be designed to allow for rapid corrective measures in case of necessity, and research should study the influence of uncertainty on the performance of management measures (risk assessment).

86. In this context it was repeatedly mentioned that research on these issues, at least in part, must be carried out independently of economic and political pressures and that the mechanism for assessing the environmental impact and assessing risks were fundamental issues requiring objective advice.

87. Optimal use of the resources is a basic concept imbodied in the UNCLOS. It relates to the avoidance of overfishing through enforcement of appropriate fishing patterns (control of effort, protection of juveniles, ensurance of minimum reproductive biomass, etc). It relates also to economic efficiency (as provided by UNCLOS) even though experience shows that this has been difficult to achieve in international fisheries. It was stressed that optimal use refers not only to the need to make the best possible use of a fish once caught, but also to optimize the use of the population it comes from. In this

respect attention was drawn to the need to consider the potential offered by species considered by-catch at present, such as slender tuna (Allothunnus fallaii) and pomfret (Brama spp.).

88. The issue of interactions between different users has many facets and it could be a major component of the problem. Interaction exists between the high seas and the EEZs, and between the various high-seas fisheries themselves. These interactions are of a "biological" nature through modification of available biomass and catch rates. They are also economic, through the modification of benefits. They also occur between fisheries and non-fishery users. The Consultation was informed that FAO was organizing an Expert Consultation on Interactions in Pacific Ocean Tuna Fisheries in early 1991.

89. Some driftnet interaction studies have been initiated (Bay of Biscay, South Pacific) and the methodology used may be appropriate for other areas. In the following discussion, reference was made to both the importance of assessing the interaction with non-fishery users and the difficulty of doing so within the framework of the existing regional fishery bodies.

90. It was mentioned that management measures on one fishery may have an interaction with another fishery, for example, through transfer of effort from regulated to unregulated fisheries or areas. This emphasises the need for coordination between management bodies and for an integrated approach to management.

91. Regarding navigation safety, the experts acknowledged there might be a problem with driftnets interfering with the legitimate use of the ocean by other vessels, although statistics on the problem were not available. It was pointed out that the main areas of concern are interaction on the fishing grounds with both fishing and merchant vessels as well as problems which occur away from fishing areas due to lost gear. This issue is also being examined by the International Maritime Organization. In addition, FAO is planning to convene an expert consultation on the marking of fishing gear in 1991.

92. It was agreed that, although the ghost fishing issue has gained attention in the media and the entanglement problem was real, there was very little scientific evidence on the real fishing efficiency of the lost gear and its lifespan. There was agreement that these problems would need to be handled regionally.

93. Better management of high-seas resources will also require improvements of the institutional arrangements at the national, regional and global levels. The experts agreed that large scale driftnet fisheries have created considerable international conflict and also that it is desirable to avoid such conflict. At the national level there is, in many countries, a need to define a fisheries policy, establish a strategy and formulate development plans which should include strengthening of research capabilities. There is also a need to improve coordination between fishery and non-fishery users of the marine environment.

94. In order to manage complex multispecies resources in the high seas properly, the management body and the research should cover all the elements in a coordinated way. Where this is not the case, it is difficult to deal efficiently with the by-catch issues and the interactions.

95. At the regional level, there are two question: is there an appropriate body and, if so, is it effective? Many fishery bodies do not, in fact, have

sufficient management capacity. In accordance with Article 64 of UNCLOS, regional management of highly migratory resources requires cooperation from all the countries concerned. There are, however, problems with such an approach, as Taiwan (Province of China) is such an important participant in the driftnet fishery. The experts urged that mechanisms be explored whereby this entity could be associated in some way in the collective effort toward a better management of fisheries.

96. There may be also a need, in some cases, for coordination between bodies in a single ocean, for instance, when long-range fleets move seasonally across the ocean or to exchange information on common problems.

97. Monitoring, control, and surveillance (MCS) are especially difficult on the high seas but necessary for effective management. It was repeatedly mentioned that international enforcement agreements are necessary. The Consultation noted that the FAO Committee on Fisheries had recommended standard specification for the marking of fishing vessels and that this was a significant step.

98. The costs of research and management, including MCS, can be considerable. Although it was agreed that investment in research to achieve sustainability was justified, the evaluation of all the impacts could be enormous and could exceed the value of the fishery. There was general agreement that the main beneficiaries of the fishery should bear most of the cost. It was mentioned that commercial operators and non-fishery users might also contribute to research. The point was also made that ability to pay may be a factor in apportioning expenses. The research and management costs should be considered when assessing the economics of the fishery, as different gear types may require different controls. The research cost associated with different types of fishing methods would be different.

99. The assessment of environmental impact and monitoring should be part of the research programmes.

b) Management approaches

100. The present situation differs between regions. Large-scale driftnet fisheries have been in existence for sometime in some areas (e.g., on North Pacific salmon, North Pacific albacore) and information on their management is available. In the South Pacific a convention has been adopted and protocols are being elaborated. In the Lesser Antilles a declaration has been adopted. Resolution 44/225 United Nations General Assembly recommended a moratorium on driftnet fishing unless effective conservation and management measures can be taken, based on sound statistical analysis. The choice of management options may well differ from region to region.

101. The Consultation noted that, in order to advise fully the competent regional fishery bodies and FAO member countries, all possible options should be examined, highlighting their potential advantages and shortcomings.

102. It was noted that most conventional management measures were potentially applicable to fisheries involving driftnets, for instance: control and limitation of fishing effort, control of the distribution of effort in space (closed areas) and/or time (closed seasons), gear modifications etc. It was also noted that a temporary or permanent ban on large-scale driftnet fishing was a central feature of the General Assembly Resolution.

103. The control of fishing effort implies determination of appropriate levels of fishing to achieve the desired objectives and a credible system of enforcement. This can include mandatory reporting, on-board observers and satellite tracking through transponders. Experience at national and international levels indicates the need for a mechanism for allocation of effort and catches between parties. This is important to reduce risk of conflict, economic innefficiency through over-investment and ecosystem overfishing. It was generally agreed that fishing effort with large-scale driftnets should not increase at the same time.

104. The use of closed areas and seasons should be based on adequate knowledge of the behaviour of fleets and on the life-cycle and migrations of the target and non-target species concerned. Research in Canada, Japan and the Republic of Korea have shown the close relationship between temperature, salinity, species and size distribution with little overlap. This information could be useful to define fishing areas by season with the aim of reducing some by-catch and undesirable interactions between fleets.

105. It was noted that Japan implements such a system in the North Pacific with seasonal adjustments of the authorized fishing zone, based on ecological considerations. Similarly it was noted that the Republic of Korea and Taiwan (Province of China) will commence similar procedures in 1990.

106. Gear restrictions and modifications might reduce the undesirable impacts by improving selectivity vis-à-vis certain species the capture of which should be avoided or reduced. The use of either active or passive sonic devices has not so far been shown to reduce cetacean mortality. Sub-surface positioning of the floatlines might reduce cetacean and sea bird by-catch and reduce navigational hazards. Reduction of gear length would reduce fishing effort and risks to navigation. Modification of the net material could reduce the lifespan of "ghost nets". The use of thin floatlines may reduce potential problems with vessel propellers. Alterations to netting material and hanging ratio could reduce the entangling of large species. More intensive research is needed, however, to verify scientifically the effectiveness of such devices and modifications.

107. The Consultation noted that a variety of specific Monitoring, Control and Surveillance measures in relation to high seas fisheries needs to be elaborated with regard to driftnet fishing. Specific examples discussed included net length or net weight limits, requirements for transponders and scientific observers.

108. In a related discussion on selectivity (or non-selectivity) of driftnets it was mentioned that there were two issues. Selectivity regarding sizes might be adequate for some species (i.e., tunas, squids) while selectivity regarding species might be a more serious problem related to entanglement. Such species-specific selectivity should in any case be gauged by the ratio between frequencies in the catch and frequencies in the surrounding population.

109. In further discussion on the justification for a temporary or permanent ban, no agreement could be reached between the experts. One view was that such a ban could only be justified if severe threats to the resources and the environment were scientifically demonstrated. The other view was that such bans could be appropriate in situations where the state and future sustainabiliity of the resources and the environment was unacceptably uncertain.

110. International research organizations, such as the International Council for the Exploration of the Seas and eventually the Pacific International Council for the Exploration of the Sea, etc., could usefully contribute to the process by evaluating MSYs and allowable catches and advising competent fishery bodies on alternative sharing formulas. They cannot, however, replace the required decision-making mechanism, an essentially politico-economic process, in the absence of which there is a high risk of poor management performance and inadequate use of the available research advice.

c) Legal Aspects

111. The Secretariat introduced this item by canvassing briefly a number of legal issues affecting the regulation of driftnets on the high seas. Among the topics referred to were: national legislation and its scope for dealing with high-seas driftnet fishing, the provisions of UNCLOS concerning the EEZ (Part V), which are capable of affecting high seas fishing, as well as the provisions of Part VII, Section 2 (the conservation and management of the living resources of the high seas). The provisions of the 1958 Convention on Fishing and Conservation of the Living Resources of the High Seas, and the principles of customary international law were also outlined. While some important differences were noted, both of the Conventions referred to and customary international law laid emphasis on the need for States to adopt conservation measures for high-seas fishing and the need for cooperation between them in establishing those measures. Brief reference was also made to other, more general, international law principles which were capable of having a bearing on the determination of rights and responsibilities over fishing on the high seas. Agreements affecting the marine environment (e.g. the IMO Conventions and the Bonn Convention on the Conservation of Migratory Species of Wild Animals) were also referred to. While there were many such agreements which in varying degrees impinged on driftnet fishing activities on the high seas, in general they either involved further agreement being reached or did not address with sufficient directness what was primarily a fisheries management and conservation issue.

112. It was recognized that the provisions of UNCLOS concerning the living resources of the high seas provided a framework for future cooperation among States for dealing with the conservation and management of fisheries beyond national jurisdiction. The Consultation took note of the duty of conservation and cooperation regarding high-seas living resources as provided for by UNCLOS. It was noted that the present International Law of the Sea as reflected in UNCLOS should not be considered deficient but that further analysis and elaboration of certain of its principles was desirable. The Consultation also drew attention to the potential role of environmental impact assessments as provided for in Article 165 and Section 4 (Monitoring and Environmental Assessment) of Part XII concerning the Protection and Preservation of the Marine Environment.

113. With respect to national regulation of driftnetting, the Secretariat informed the consultation that FAO has started a collection of national legislation on the subject and that any additional information would be highly appreciated.

RECOMMENDATIONS FOR FUTURE ACTION

a) Catch and Effort Data

114. Recognizing the gaps in catch and effort data in the detail required to allow scientists to make reliable assessments, the Consultation recommended

that a coordinated effort be made to compile as complete a historical information base as possible by species, season, area, gear and methods for the fisheries involving driftnets.

115. In this respect, the Consultation considered that it was the duty of all concerned in the prosecution of fisheries involving driftnet fishing on the high seas to make available to other States and international organizations, all available data including biological data.

116. The Consultation recommended the development of a comprehensive data collection system for application on a global basis. It is further recommended that the system should also address non-target species, discards and drop-outs and that the system should not be limited to fisheries. Useful information could be collected from the fishing industry. It was suggested that FAO should evaluate the feasibility and financial implication of setting-up such a central system.

b) Incidental catches

117. In relation to non-target species, attention was drawn to the need for specific data on incidental catches as well as population levels and that this latter may also have to be addressed by non-fisheries oriented institutions or organizations. In this connection, the Consultation recommended that attention be given to facilitate the placement of observers on board commercial driftnet vessels.

118. Given that the strategy reducing by-catches might not be fully effective, the Consultation recommended that efforts be made to reduce discards and wastage of commercial valuable species from the catch.

c) Bio-economics

119. Considering the importance of bio-economic fisheries interactions, it is recommended that further work should be carried out on this issue.

d) Design of Fishing Gear

120. The Consultation noted that properly designed and rigged drifting gillnets could be selective by size of fish, but that the gear commonly in use on the high seas allowed entanglement of both target and non-target species. For large-scale driftnet fishing it recommended that much attention should be given to the development of alternative fishing gear in relation to species selectivity and the improvement of gear in general to ensure survival of escapements.

121. Further research should be carried out, in different fishing areas, to assess the effects of gear modification and operational controls in reducing the incidental catch of non-target species.

e) Lost and Discarded Gear

122. The Consultation recommended that research be intensified on the fate and impact of lost and discarded gear.

f) Navigational Hazards

123. Considering the navigational hazards created by large-scale driftnets, international cooperation to reduce these hazards is recommended. The

Consultation took note of the request of the Eighteenth Session of the Committee on Fisheries to review the collision regulation in relation to "lights and shapes" and that FAO is submitting this request to the Fifty-eighth Session of the Maritime Safety Committee of the International Maritime Organization. Specifications should therefore be developed for unattended fishing gear, including driftnets, and means to enforce compliance with the specifications.

g) Monitoring of the fleets

124. To facilitate monitoring of large-scale driftnet fleets, it is recommended that, in the spirit of international cooperation, distant-water fishing nations provide lists of licensed vessels and their areas of operation to the countries and management bodies concerned. It also encouraged all nations fishing for high-seas resources to require their vessels to carry satellite tracked transponders.

h) Regional Management Bodies

125. Considering the lack of regional management bodies in some areas or in some cases their limited effectiveness where they do exist, it is recommended that such organizations be established or reinforced as the case may be. Joint cooperative research programmes should also be encouraged.

126. Recognizing the appropriateness of the regional approach, advocated by the General Assembly Resolution, it is recommended that coordination should be developed between regional fisheries bodies, for example, to exchange scientific data, to organize joint working groups or share information on long-range fishing fleet activities and evaluate the feasibility of centralizing information on long-range fishing activities.

i) Governmental Consultation

127. The Consultation stressed that the matter of driftnet fishing was of such importance that it would need further consideration at governmental level. In this context, it noted that it will be considered at forthcoming meetings of several FAO regional fishery bodies (comprising about 80 FAO Member Nations) and at the Nineteenth Session of the Committee on Fisheries. The Consultation recommended that the convening of a special governmental consultation be considered subject to the availability of funds.

j) Legal regime of high seas fishing

128. The Consultation recommended that more attention should be given to legal rules and principles relevant to driftnet fishing on the high seas. It also recommended that further study of the legal regime governing high-seas fishing should be undertaken by FAO possibly in collaboration with other UN bodies, in particular, the UN Office for Ocean Affairs and the Law of the Sea.

ADOPTION OF THE REPORT

129. This report was adopted on 6 April 1990.

APPENDIX A

Agenda of the Consultation

1. Opening of the Consultation

2. Election of officers and arrangements for the meeting

3. Adoption of the Agenda

4. Assessment of the present situation

   (a) Summary of discussions on the question in various international fora

   (b) Experts reports on research undertaken to assess the impact of large-scale pelagic driftnet fishing on marine living resources

5. Review of management options

6. Recommendation for future action

   (a) Additional work recommended

   (b) Additional legal measures recommended

7. Any other matter

8. Adoption of the report

APPENDIX B

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APPENDIX C

List of Documents

The following documents, collected by the Secretariat were made available to the experts:

A. Resolutions, Declarations, Legislations, International Agreements and Deliberations of International Organizations

- Resolution 44/225 on Large-Scale Pelagic Driftnet Fishing and Its Impact on the Living Marine Resources of the World's Oceans and Seas adopted on 22 December 1989 by the General Assembly of the United Nations.

- Statement by FAO in the Second Committee of the General Assembly (44th Session) on the question of Large-Scale Pelagic Driftnet Fishing.

- Discussions on Driftnet at the 25th Session of the FAO Conference (11-30 November 1989) (excerpts from the Verbatim).

- Document C89/Inf.17 "Large-Scale Pelagic Driftnet Fishing" distributed to the Conference of FAO at its 25th Session.

- Excerpts from the Report of the Ninth Session of the Indian Ocean Fisheries Commission (Mahé, Seychelles, 2-6 October 1989).

- Excerpts from the Report of the 48th Session of the Executive Committee of the General Fisheries Council for the Mediterranean (Rome, 14-16 February 1990).

- The Tarawa Declaration (10-11 July 1989) adopted by the South Pacific Forum.

- Agreed Record of Proceeding of the First Meeting of the Southern Pacific Albacore Driftnet Fishery (Suva, Fiji, 26-28 June 1989).

- Record of Proceedings on the Second Consultation on Arrangements for the South Pacific Albacore Fisheries Management (Honiara, Solomon Islands, 2-7 March 1990).

- Driftnet Resolution adopted by the 29th South Pacific Conference (Guam, 9-11 October 1989).

- United States Statement on Driftnet Fishing presented at the 65th Session of the Fisheries Committee, Organization for Economic Cooperation and Development (OECD) (6-9 March 1990).

- The Castries Declaration adopted by the Authority of the Organization of Eastern Caribbean States (OECS) (St. Lucia, 20-24 November 1989).

- Motion adoptée par le Groupe de travail sur les mammifères marins de la Commission Internationale pour l'Exploration Scientifique de la Mediterranée (Sète, 18 octobre 1989).

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- Excerpts from the Proceeding of the 1989 Meeting of the International Commission for the Conservation of Atlantic Tuna (Madeira, 13-17 November 1989).

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- Australia: Fisheries Notice No.88 of 12 June 1979 Prohibition relating to the taking of fish by trammel net, tangle net or gillnet in proclaimed waters off the coast of New South Wales.

- Australia: Fisheries Notice No.113 of 27 July 1983 Prohibition relating to the taking of fish by trammel net, tangle net or gillnet in proclaimed waters off Tasmania.

- Australia: Fisheries Notice No. AFZ1 of 20 July 1989. Australian Fishing Zone, Prohibition of Pelagic Gillnet and Driftnet Fishing.

- United States: Driftnet Impact Monitoring, Assessment and Control Act of 1987.

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- Italy: Decreto 20 luglio 1989, Divieto di concedere nuove licenze per l'uso di reti derivanti nonché divieto dell'uso delle stesse nel mese di ottobre per la pesca del pesce spada e dell'alalunga.

- Italy: Decreto 25 ottobre 1989, Divieto dell'uso di reti derivanti per la pesca del pesce spada e dell'alalunga dal 1° novembre 1989 al 31 marzo 1990.

- Japan: Measures taken by the Government of Japan on the Japanese Driftnet Fisheries (Note of 24 January 1990 from the Embassy of Japan, Rome).

- Exchange of letters between the American Institute in Taiwan and the Coordination Council for North American Affairs (13 July 1989 - 24 August 1989).

- Exchange of letters between the United States of America and the Republic of Korea, 8 September 1989.

- Exchange of letters between Canada, Japan and the United States of America, 2 May 1989.

- Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific done in Wellington on 24 November 1989 (together with two draft protocols).

- Driftnetting on the High Seas. Information document on driftnets for the 44th Session of the General Assembly of the United Nations, Greenpeace International, November 1989.

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APPENDIX D

Opening Statement by
Dr Armin Lindquist, Assistant Director-General
(Fisheries Department)

Ladies and Gentlemen,

On behalf of the Director-General of FAO, I wish to welcome you to this Expert Consultation on Large-Scale Pelagic Driftnet Fishing. The Conference of FAO in November 1989 discussed this issue for which an information paper had been prepared by the Fisheries Department, giving the background for the development of that fishery. Please allow me to highlight some of the points raised in it:

As you know, rapid advancement has been made in fishing vessel and gear technologies, especially the development of light, durable synthetic fibres for use in the construction of fishing nets. New gears developed and traditional gears could be constructed in a new manner and of greater size. In general, the result is that the fishing vessels tend to be deployed in the area most likely to give prolific catches. If the fishery then remains unmanaged, it will result in overfishing of target species and affect non-target species.

A factor that probably contributed to the rapid expansion of the large-scale pelagic driftnet fishery is the opening of new markets in the world, particularly in Asia, in response to steadily increasing demands for fish and fish products and the consequent rise in fish prices.

The Conference recommended that FAO should undertake further action, including analytic scientific work, to improve the information available. In the following month, the UN General Assembly adopted a Resolution requesting "specialized agencies, particularly the Food and Agriculture Organization", to study urgently large-scale pelagic driftnet fishing and its impact on the living marine resources and to report their views to the Secretary-General.

In order to follow up these requests, the Director-General of FAO has set up an internal Task Force and decided to convene this Expert Consultation. The purpose is to study the matter in detail and to advise on further work to be carried out and measures to be taken by FAO and its regional fishery bodies.

I wish to say a few words about the composition of the group: you have been selected according to your specialized knowledge in matters of immediate importance to driftnet fishing. This has been an easy task because your experience is well known. However, we recognized that there are other eminent experts around the world. We had to limit the size of this group while, at the same time maintaining as wide a geographical distribution as possible. As you are aware, this is not a Governmental Consultation where all countries interested would have had an opportunity to be represented; in this meeting technical knowledge in different fields has been the criterion for selection.

The draft agenda includes the following:

(1) Assessment of the present situation

(2) Review of management options

(3) Recommendations for future action.

The information on large-scale pelagic driftnet fishing collected so far by the Fisheries Department is at your disposal at this meeting. This does not signify an endorsement by FAO of all the views expressed therein. We hope to receive from you additional information to fulfil the mandate given by the FAO Conference.

We are concerned with driftnet fisheries in the high seas, where there are great economic interests. There is growing concern about the development of this fishery, the health of the stocks fished upon and the incidental catches of mammals, turtles and birds. A ban on driftnet fishing is being urged by many. In this context, economics, rational use of living resources and sustainable development are fundamental matters, which have attracted the attention of a wide audience. This Expert Consultation is not the place to repeat the arguments put forward or the positions being taken. They are all well known to us. Our difficult task will be to collect facts to try to evaluate the impact of large driftnets on living resources, review management options and, I repeat, recommend to FAO and to the international community additional work to be carried out and measures to be taken in this context.

This may require some patience but it will undoubtedly be worth the efforts.

What kind of new data can be expected? Of course we are expecting that you will provide this information; that is the reason for gathering here. There may be new figures on drop-outs of albacore from nets and on their damage. There may be information on the navigational hazards of such nets. Regarding the construction of nets: lowering of the nets well below the surface may reduce the incidental catch of mammals: has this observation been confirmed? What is a "large" pelagic driftnet, how should it be defined? Would another gear be more adequate and acceptable for catching albacore? What do we know about driftnet fisheries in the Indian Ocean? Would a management scheme be effective without the participation of all the parties involved? These are only some examples of the questions to be discussed and we have prepared some guidelines for discussion of the different items to be introduced by FAO staff. When it comes to recommendations for future actions, they will emanate directly from your advice. We are particularly interested in receiving your sugggestions regarding any special studies that are required, other persons or institutions that should be consulted, or other ways in which FAO might appropriately respond to the request of the General Assembly.

Finally, I would like to mention that the matter of driftnet fishing has been recently discussed by the Executive Committee of the General Fisheries Council for the Mediterreanean (GFCM) and you wil be informed of its findings. Furthermore, driftnet fishing will be discussed at the Session of the Indo-Pacific Fisheries Commission in May, the Indian Ocean Fisheries Commission's Tuna Committee in July and at the Session of the Western Central Atlantic Fishery Commission/Lesser Antilles Committee in November. Your advice for these meetings being held at a governmental level will be very helpful.

Thank you.

APPENDIX E

Resolution 44/225 of the General Assembly on Large-Scale Pelagic Driftnet Fishing and Its Impact on the Living Marine Resources of the World's Oceans and Seas

The General Assembly

Noting that many countries are disturbed by the increase in the use of large-scale pelagic driftnets, which can reach or exceed 30 miles (48 kilometres) in total length, to catch living marine resources on the high seas of the world's oceans and seas,

Mindful that large-scale pelagic driftnet fishing, a method of fishing with a net or a combination of nets intended to be held in a more or less vertical position by floats and weights, the purpose of which is to enmesh fish by drifting on the surface of or in the water, can be a highly indiscriminate and wasteful fishing method that is widely considered to threaten the effective conservation of living marine resources, such as highly migratory and anadromous species of fish, birds and marine mammals,

Drawing attention to the fact that the present resolution does not address the question of small-scale driftnet fishing traditionally conducted in coastal waters, especially by developing countries, which provides an important contribution to their subsistence and economic development,

Expressing concern that, in addition to targeted species of fish, non-targeted fish, marine mammals, seabirds and other living marine resources of the world's oceans and seas can become entangled in large-scale pelagic driftnets, either in those in active use or in those that are lost or discarded, and as a result of such entanglement are often either injured or killed,

Recognizing that more than one thousand fishing vessels use large-scale pelagic driftnets in the Pacific, Atlantic and Indian Oceans and in other areas of the high seas,

Recognizing also that any regulatory measure to be taken for the conservation and management of living marine resources should take account of the best available scientific data and analysis,

Recalling the relevant principles elaborated in the United Nations Convention on the Law of the Sea. 1/

Affirming that, in accordance with the relevant articles of the Convention, all members of the international community have a duty to co-operate globally and regionally in the conservation and management of living resources on the high seas, and a duty to take, or to co-operate with others in taking, such measures for their nationals as may be necessary for the conservation of those resources,

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1/ Official Records of the Third United Nations Conference on the Law of the Sea, vol. XVII (United Nations publication, Sales No. E.84.V.3), document A/CONF.62/122.

Recalling that, in accordance with the relevant articles of the Convention, it is the responsibility of all members of the international community to ensure the conservation and management of living marine resources and the protection and preservation of the living marine environment within their exclusive economic zones,

Noting the serious concern, particularly among coastal States and States with fishing interests, that the overexploitation of living marine resources of the high seas adjacent to the exclusive economic zones of coastal States is likely to have an adverse impact on the same resources within such zones, and noting also, in this regard, the responsibility for co-operation in accordance with the relevant articles of the Convention,

Noting further that the countries of the South Pacific Forum and the South Pacific Commission, in recognition of the importance of living marine resources to the people of the South Pacific region, have called for a cessation of such fishing in the South Pacific and the implementaiton of effective management programmes,

Taking note of the adoption of the Tarawa Declaration on this subject by the Twentieth South Pacific Forum at Tarawa, Kiribati, on 11 July 1989 1/ and the adoption by South Pacific States and territories of the Convention on the Prohibition of Driftnet Fishing in the South Pacific, at Wellington on 24 November 1989, 2/

Noting that some members of the international community have entered into co-operative enforcement and monitoring programmes for the immediate evaluation of the impact of large-scale pelagic driftnet fishing,

Recognizing that some members of the international community have taken steps to reduce their driftnet operations in some regions in response to regional concerns,

1. Calls upon all members of the international community, particularly those with fishing interests, to strengthen their co-operation in the conservation and management of living marine resources;

2. Calls upon all those involved in large-scale pelagic driftnet fishing to co-operate fully with the international community, and especially with coastal States and the relevant international and regional organizations, in the enhanced collection and sharing of statistically sound scientific data in order to continue to assess the impact of such fishing methods and to secure conservation of the world's living marine resources;

3. Recommends that all interested members of the international community, particularly within regional organizations, continue to consider and, by 30 June 1991, review the best available scientific data on the impact of large-scale pelagic driftnet fishing and agree upon further co-operative regulation and monitoring measures, as needed;

4. Also recommends that all members of the international community, bearing in mind the special role of regional organizations and regional and

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1/ See A/44/463, annex.

2/ See A/44/807

bilateral co-operation in the conservation and management of living marine resources as reflected in the relevant articles of the United Nations Convention on the Law of the Sea, agree to the following measures:

(a) Moratoria should be imposed on all large-scale pelagic driftnet fishing by 30 June 1992, with the understanding that such a measure will not be imposed in a region or, if implemented, can be lifted, should effective conservation and management measures be taken based upon statistically sound analysis to be jointly made by concerned parties of the international community with an interest in the fishery resources of the region, to prevent unacceptable impact of such fishing practices on that region and to ensure the conservation of the living marine resources of that region;

(b) Immediate action should be taken to reduce progressively large-scale pelagic driftnet fishing activities in the South Pacific region with a view to the cessation of such activities by 1 July 1991, as an interim measure, until appropriate conservation and management arrangements for South Pacific albacore tuna resources are entered into by the parties concerned;

(c) Further expansion of large-scale pelagic driftnet fishing on the high seas of the North Pacific and all the other high seas outside the Pacific Ocean should cease immediately, with the understanding that this measure will be reviewed subject to the conditions in paragraph 4 (a) of the present resolution;

5. Encourages those coastal countries which have exclusive economic zones adjacent to the high seas to take appropriate measures and to co-operate in the collection and submission of scientific information on driftnet fishing in their own exclusive economic zones, taking into account the measures taken for the conservation of living marine resources of the high seas;

6. Requests specialized agencies, particularly the Food and Agriculture Organization of the United Nations, and other appropriate organs, organizations and programmes of the United Nations system, as well as the various regional and subregional fisheries organizations, urgently to study large-scale pelagic driftnet fishing and its impact on living marine resources and to report their views to the Secretary-General;

7. Requests the Secretary-General to bring the present resolution to the attention of all members of the international community, intergovernmental organizations, non-governmental organizations in consultative status with the Economic and Social Council, and well-established scientific institutions with expertise in relation to living marine resources;

8. Requests the Secretary-General to submit to the General Assembly at its Forty-Fifth Session a report on the implementation of the present resolution.

85th plenary meeting
22 December 1989

APPENDIX F

Excerpt from the Report of the 25th Session of the Conference of FAO

47. The Conference noted the serious concern expressed by some Member Nations over the increasing use of large-scale pelagic driftnets, particularly in the South Pacific Ocean. It noted that this issue was also being currently considered in the UN General Assembly, which had draft resolutions before it. Some Member Nations stated that already there was sufficient evidence of the negative impact of large-scale high seas driftnets to warrant the international community supporting an immediate ban on their use. They also stressed that this action should not be delayed pending the outcome of any further analysis. However, some other Member Nations were of the view that little scientific evidence was available on this issue to justify a ban on the use of large-scale pelagic driftnets and referred to measures that had already been taken by some countries. The Conference agreed that FAO was the most appropriate technical organization to study this matter. The Conference noted the steps already taken by FAO and agreed that this issue should continue to receive the Organization's close attention. The Conference recommended that, as far as it was feasible, and in the light of the outcome of the UN General Assembly's debate on the above-mentioned draft resolutions, FAO should undertake further action, including analytic scientific work, to improve the information available. The Secretariat should report on progress in this matter to the next session of the Committee on Fisheries.

APPENDIX G

Data Needs and Availability for South Pacific Albacore Fisheries

(Submitted by Mr T. Murray)

Nominal catch and effort data for longline and troll fisheries has been available since the beginning of these fisheries and has served as the basis for stock production modelling. In addition size composition of longline and troll landings has been monitored for most of the periods of operation of these fisheries. Data on catch and effort in the large-scale pelagic driftnet fishery is still very limited. Information on the driftnet fishery is presently restricted to size composition data from transshipments from the first half of the Japanese season in 1988/89 and from JAMARC research cruises. Crude driftnet catch estimates are currently derived from information provided by the Japan Fisheries Agency (for Japan) and from estimates of average catch per trip by the Japanese fleet conservatively scaled upwards for the fleet size estimated through surveillance and other sources (for Taiwan P.C.).

South Pacific and U.S. scientists have been working together since 1986 to improve the data available for stock assessment and to coordinate research. This ad hoc arrangement has been formalized during consultation between the South Pacific region and all distant water fishing interests except Taiwan P.C. who as yet has refused to enter discussions. At the Second Consultation on Arrangements for South Pacific Albacore Fisheries Management, agreement has been reached for data to be provided to the South Pacific Commission (SPC) by all fishing parties in an agreed format. SPC, on behalf of the recently constituted Scientific Advisory Group, will compile all data and make it available for distribution to nominated members of the Scientific Advisory Group on request.

The specific data required now and the time of data submission has been agreed as follows:

- Monthly catch and effort data by 5 degree square will be provided for longline fisheries for each calendar year to be submitted by 30 June, 18 months after the completion of the fishing year. Provisional estimates of total catch and effort will be provided by 1 January, 6 months to the submission of detailed data.

- For surface fisheries monthly catch and effort data by 5 degree square will be provided for the 12 month period 1 July to 30 June, by 1 September of that year. Provisional estimates of total catch and effort will be provided by 1 July.

- Size composition data will be provided on a 5 degree latitude by 10 degree longitude by month basis at the same time as detailed catch and effort statistics are submitted.

In addition to catch and effort data a number of research projects throughout the region continue to be coordinated through SPC to provide data in support of stock assessment (e.g., studies to provide information on or estimates of growth rate, natural mortality, recruitment, seasonality of spawning, stock structure, migration, and distribution).

The largest gaps in data required relate to the absence of historical catch and effort data for the driftnet fishery and the continuing lack of a fisheries statistics collection mechanism for the Taiwanese driftnet fleet. The recent entry of driftnet vessels into the South Pacific suggests that it may still be possible to collect nominal catch and effort data from this fishery through commercial sources. The provision of historical driftnet fishery data was identified as a high priority at the last South Pacific Albacore Research (SPAR) workshop but has not been implemented as yet.

APPENDIX H

Description of Japanese Pelagic Driftnet Fisheries and Related Information

By

Ziro Suzuki

1. INTRODUCTION

Driftnetting has long been practised throughout the world from the coast to the high seas to catch a wide variety of fish. This fishing gear is effective in catching the target fish which are sparsely distributed in low densities in the surface layer of the ocean. It could be used as a selective gear, to some extent, by adjusting the mesh size and hanging depth and by enforcing appropriate restrictions as to area and time of operation.

Concern has been expressed recently by some countries regarding the pelagic driftnet fisheries (hereafter referred to as driftnet fisheries unless otherwise specified), of which there are three types: for salmon, squid and large-mesh driftnet. Although the three types require a specific licence or registration for respective operations, there are substantial numbers of driftnet boats able to operate (although not simultaneously in a single cruise) two or all three categories of the driftnet fishery by changing the different meshed nets.

The driftnet fisheries are active mostly from dusk to dawn; the nets being suspended from the sea surface to 8-10 m depth. Mesh size varies according to the type of fishery: 110-130 mm (streched) for the salmon; 110-120 mm for the squid and 170-180 mm for the large-mesh driftnetters. The minimum unit of the nets is the tan, usually 30-50 m long. About a hundred tans of nets linked together form a section 3-5 km long, and various numbers of hari section (mostly 4-10 sections, disconnected from each other at intervals) are deployed in any one fishing operation.

2. FISHING GROUNDS AND FISHING SEASONS

2.1 Salmon Driftnet

Japan's salmon fishery has been conducted under the regulation scheme of target species, based on agreements with USSR, Canada and the USA since 1952 in the areas confined to west of 175°W. Those countries and Japan are major "States of origin" for Pacific salmon. There are two types of salmon driftnet fishery; one uses a mothership and the other is land-based operating on a single-boat basis.

The numbers of salmon driftnet fisheries have been steadily decreasing, particularly since 1987. The number and typical size in gross tonnage (GT) of the boats operated in 1989 were 56 boats and about 127 GT for mothership-type driftnetters (Table 1). For the land-based fishery, there were 156 boats with sizes ranging from 30 to 127 GT. Salmon are the target species for this fishery which is mainly operated from June to July. Submission of logbooks has been compulsory for this activity. (The present fishing grounds are shown in Figure 1.)

2.2 Squid Driftnet

The squid driftnet fishery, the most recent of the three, started in the late 1970s in the grounds off Sanriku, the northeastern areas of the Pacific coasts of Japan, and then spread rapidly to the offshore oceanic waters. Since 1981, operations have been limited to the area east of 170°E, west of 145°W and north of 29°N. At the same time, the number of boats has been restricted and the fishermen are obliged to submit reports on catches. The northern fishing boundary has been established on a monthly basis according to the segregation of distribution between flying squid and salmon, up to 46°N in order to avoid incidental catches of salmon. Fishing is limited from June to December, peaking from July to September. (Fishing grounds are shown in Figure 1). The number of boats has been slightly declining and there were 463 units in 1988 (Table 1). Boat sizes range from 100 to 500 GT with the major size class at 234 GT. This fishery targets on flying squid (Ommastrephes bartrami).

2.3 Large-Mesh Driftnet

This is the oldest of the three driftnet fisheries, dating back approximately 100 years. In its earlier period, operations were localized in coastal Japanese waters. Large-scale offshore operations were initiated in the North Pacific from the mid 1970s and later in the South Pacific from the mid 1980s.

The number of boats operated in 1988 was 459, ranging from 100 to 500 GT (Table 1). The target species is albacore. A registration system, which requires large-mesh driftnet fishermen to record their fishing plans, was introduced in 1989. Submission of reports on catches is compulsory.

The operations of this fishery are prohibited all along the Pacific coastal areas, but permitted in the Japanese waters (Figure 2). Major fishing seasons are from January to May in the North Pacific and December to February in the South Pacific. Operations are conducted in the northern winter in the South Pacific fishing grounds when bad weather prevails in the North Pacific.

3. ASSESSMENT OF THE IMPACT OF THE LARGE-SCALE PELAGIC DRIFTNET FISHING ON TARGET AND NON-TARGET SPECIES

3.1 Target Species

3.1.1 Salmon

At present there is no cause for concern regarding the status of the salmon stocks. Salmon catches in coastal areas in North America and Japan have reached historically high levels in recent years. Since restrictions on the salmon driftnet operations in the open seas have been strengthened, the impact of driftnet fisheries on salmon populations has in general decreased.

3.1.2 Flying squid

Biological information, such as stock structure, growth and mortality rate, is important to stock assessment of many marine fishery species, including tunas and groundfish. However, because of the short lifespan (1-2 years) of flying squid, the usual procedure for stock assessment is not applicable to this species. Trends in catch, fishing effort and CPUE are shown in Table 2 (Anon., MS.) for stock utilized by the driftnet fishery in the areas between 170°E ad 145°W. There are no flying squid fisheries exploiting the stock in these waters other than the driftnetters. Operations covered the

entire grounds in 1982 and fishing effort reached a peak in 1986. The CPUE was highest in 1983 followed by a moderate decline, but with no consistent upward or downward trend. The rather wide annual fluctuation in the observed CPUE may result from the short lifespan (one or two years) of this species.

Although no conclusion can be drawn at this stage on status of stock, the level of the driftnet effort in recent years does not appear to place any serious risk on the sustainability of current catches.

3.1.3 Albacore

North Pacific stock

This stock has been the object of surface fisheries using pole-and-line or troll as well as of the longline fishery. There was no concern regarding the status of this stock until recently (Miyabe and Bartoo, 1987); it was considered that the resource had been exploited substantially below the level of maximum sustainable yield (MSY) and was in a healthy condition. The MSY estimated using data up to 1985 ranged from 86 000 to 136 000 t, with a 65 000 t catch in 1985.

However, during the North Pacific Albacore Workshop (NPAW) held in 1989, some concern was voiced as to the status of the stock. The relevant statistics presented the NPAW are shown in Table 3 and Figure 3. The cause for alarm issues from: (1) a decline in recent years of the revised CPUE for the USA troll fishery which used to show an increasing trend on the basis of the previous calculation method; (2) a slight decline in the Japanese longline CPUE in 1986; (3) apparent low abundance of younger age-classes, 3 and 4, which constitute an important part of the catch of the surface fisheries.

There is one view that increased effort of the squid driftnet in recent years may be one of the causes of the apparent decline in stock because other major albacore fisheries are either reducing their fishing effort (Japanese pole-and-line fishing and USA troll fishing) or remained stable (Japanese longline and large-mesh driftnet fisheries). On the other hand, there is also an opinion that those observations may be due to environmental phenomena such as El Niño. An additional justification for the non-fishery related view is that the longline CPUE, which reflects abundance of the adult fish population, did not show any sign of decline after the record high catches of juvenile fish by the surface fisheries; 80 000-90 000 t in the early to middle 1970s (Table 3). Therefore, data should be analysed to determine if the decline is real or an artifact. A joint study between the Japanese, USA and other interested scientists is now being planned to investigate these problems.

In conclusion, the impact of the driftnet fisheries on this stock is not known at present, partly because of incomplete catch and effort statistics of the driftnet fisheries.

South Pacific stock

This stock has long been fished exclusively by longlining with relatively small amounts caught by trolling (Tables 4 and 5). The large-mesh driftnetters began operations in the South Pacific in the 1980s, with large-scale operation from 1989. Their activities, with a simultaneous increase of trolling catches, caused serious concern regarding the albacore fishery and the stocks due to the rapid and large influx of fishing effort (Anon., 1989(a)). However, the catches of albacore were substantially lower in the 1989-1990 season, close to

the levels before 1987 when large-scale operations began; that is, comparable to present catches of the trolling fisheries.

There are no published papers on assessment of the impact of the driftnet fishery on the resources. This is due to the lack of biological information for the South Pacific stock as well as incomplete catch statistics for the driftnet fishery.

Although it is difficult to quantify the impact of the driftnet fishery on the stock, there appears to be no threat of collapse as long as the catches of the surface fisheries, including trolling, remain at present levels.

3.2 Non-Target Species

Many species are captured incidentally by the driftnet fisheries. Those species of which the change in population size, in either absolute or relative values is known, is outlined below:

The North Pacific stock of striped marlin (Tetrapturus audax) has been fished by longlining and large-mesh driftnetting. The share of the longline catches in the total catch is decreasing, and after the middle of the 1970s the catches by large-mesh driftnet show a magnitude comparable to the longline catches (Table 5). Suzuki (1989) inferred that the overall fishing impact of the northern stock is not high enough to be a dominant factor in changing the stock size.

Skipjack (Katsuwonus pelamis) and swordfish (Xiphias gladius) are indidentally captured in the large-mesh driftnet fishery. Although these catches are sometimes substantial, it is generally held that there is still scope for further exploitation of the Pacific skipjack stock. Regarding swordfish, the status of the Pacific stock was healthy up to 1985 (Bartoo and Coan, 1989). Since 1985, the fishery for the Pacific swordfish is basically unchanged. Therefore, it is considered that the exploitation of this stock by the large-mesh driftnet will not affect the population size.

Ohsumi (1987) estimated the impact of the salmon and squid driftnet fisheries on the population of Dall's porpoise (Phocoenoides dalli). The impact was small; the population size projected for 1992, ranged from 87 to 99% of the virgin stock size (84-99% in 1985 based on latest available data). This range remains well above a level of 60% which corresponds to a lower limit of the optimum sustainable population. No trends in yearly CPUE changes for Dall's porpoises incidentally captured by the salmon driftnet boats, and the same observation for the sighting survey (Oshumi, 1987), support the view that the estimated impact is small.

Concern regarding the decline of the Pribilof fur seal (Callorhinus ursinus) has been registered, since the population size of this animal decreased to about 0.8 million, i.e., only about a half of the peak abundance of the early 1950s (e.g., Trites and Lakin, 1989). Several causes for the decline are proposed: e.g., female kills, reduction in the fur seal food, death by entanglement in lost nets; driftnet operations; environmental changes. However, the decline of the Pribilof fur seal was substantially marked and already observed in the 1970s before the squid driftnet fishery of Japan begun and there is no significant trend of variation of this stock in the 1980s. Therefore, it is evident that the cause of decline cannot be attributed to the driftnet fishery. No definite single cause for the decline in population has yet been demonstrated. Therefore, collection and analyses of detailed data on any deaths of the fur seals related to this stock are urgently required.

4. RESEARCH

Research on the driftnet fisheries has been continued in Japan. Information recently made available is briefly described below:

4.1 Avoidance of Incidental Catches of Non-Target Species

Incidental catches of the non-target species by the driftnet fisheries (and this applies to any non-selective fishery) should be reduced to the minimum. Recent preliminary studies indicate that subsurface driftnets suspended a few metres below the sea surface substantially reduced most of the incidental catches of the non-target species without lowering the catching efficiency on the targetted South Pacific albacore in the Tasman Sea (Watanabe, MS.). A similar result was obtained with the use of the subsurface driftnet operated in the offshore areas east of New Zealand (Y. Watanabe, personal communication).

The results showed that no marine mammals, sea birds and marine turtles were captured by the subsurface driftnet suspended 2 m below the sea surface during 18 operations with 18 sections of net, while 60 dolphins and 4 bottlenose whales, 4 sea birds and 3 marine turtles were enmeshed by the common type driftnet during 22 operations with 175 sections of net (Watanabe, MS.).

4.2 Estimation of Drop-Out Rates

Preliminary estimation of the drop-out rate during net retrieval resulted in 7% on average for the South Pacific albacore taken by the large-mesh driftnet operations (Watanabe, personal communication). There is no information of the drop-out rates during the period the nets are set in the sea.

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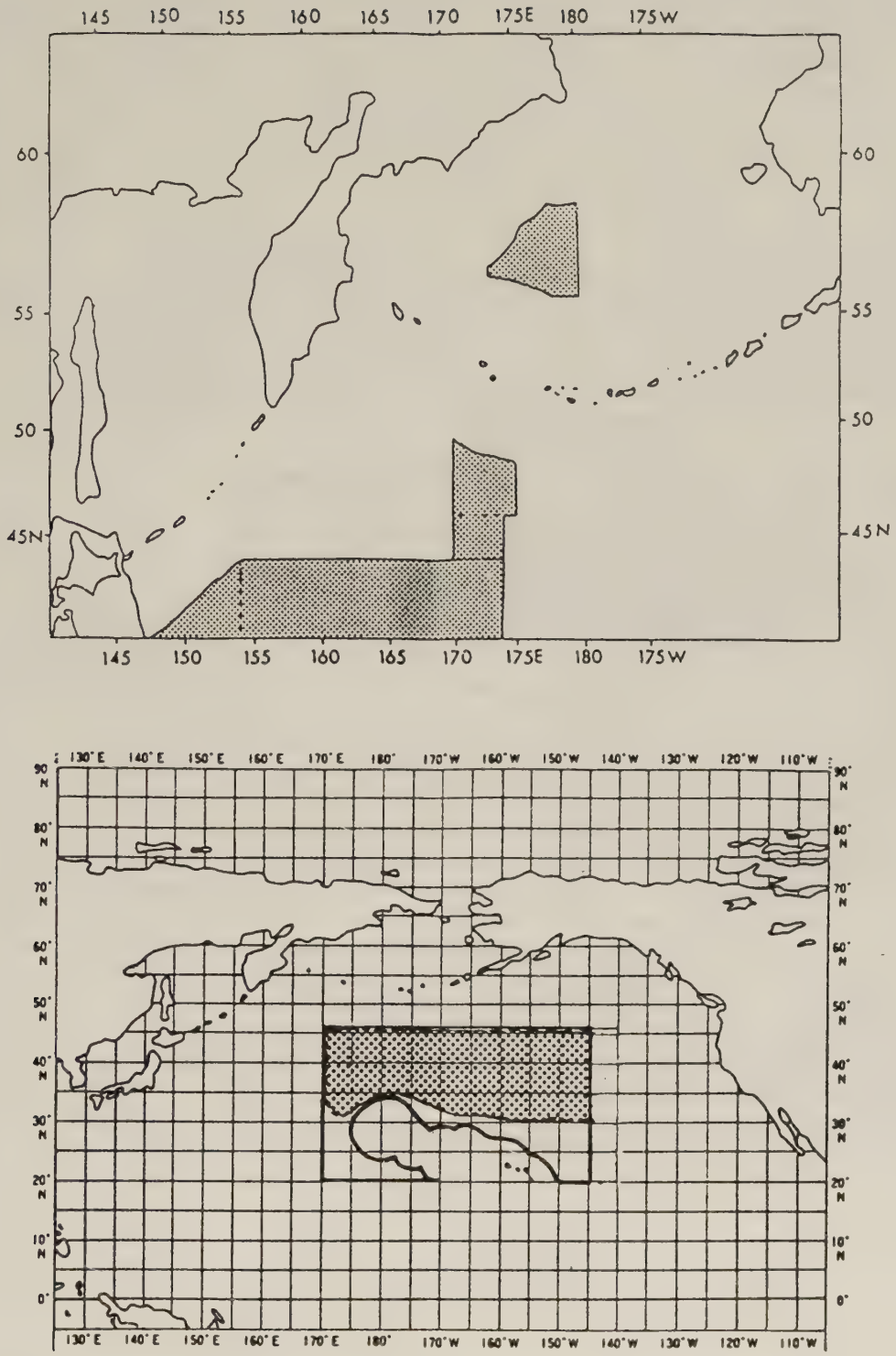

Figure 1 Schematic representation of fishing ground (shaded) of Japanese salmon (upper) and flying squid (lower) driftnet fisheries.

Areas inside the thick lines are open to the activities of the flying squid fishery.

Figure 2 Schematic representation of fishing grounds (shaded) of Japanese large-mesh driftnet fishery.

Operations within the areas delineated by the thick lines are prohibited (Note: In addition, operations are prohibited within the 200-mile zone of any foreign coastal States unless the permission of that State is granted).

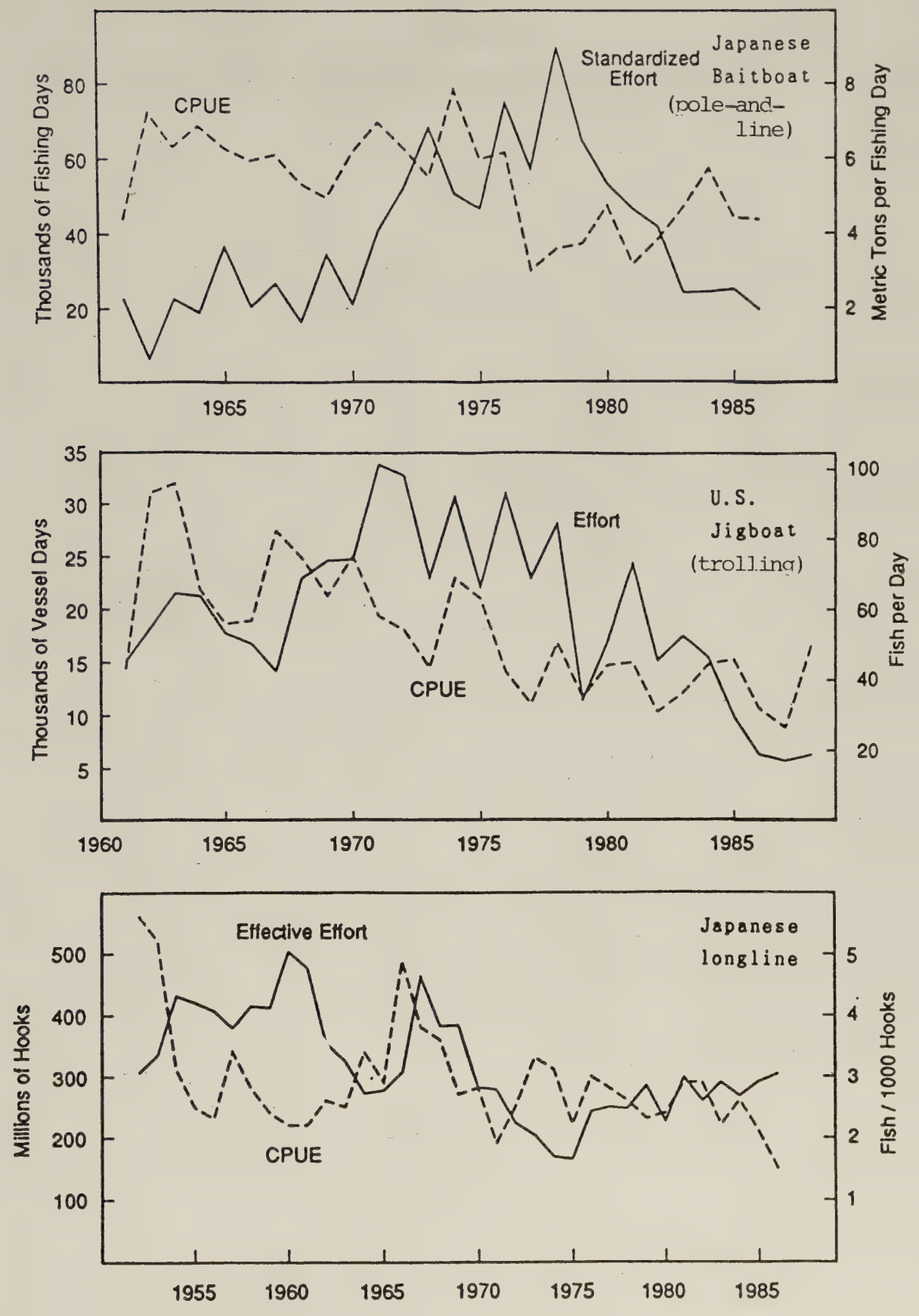

Figure 3 Trend of effort and CPUE for various North Pacific albacore fisheries. Data from Anonymous b (1989).

Table 1

Number of boats operated and catches (MT) for Japanese driftnet fisheries

Squid fishery			Large-mesh fishery	
Year	No. Boats	Catch	No. Boats	Catch
1983	515	215,785	620	37,887
1984	505	123,722	547	33,750
1985	502	197,834	470	31,640
1986	492	152,230	474	36,469
1987	478	208,448	460	25,070
1988	463	157,772	459	40,083

(No. of boats, including small scale large mesh fishery, are estimated)

Mothership salmon fishery			Landbased salmon fishery	
Year	No. Boats	Catch	No. Boats	Catch
1983	172	15,414	209	20,342
1984	172	14,522	207	14,782
1985	172	12,466	209	15,493
1986	172	6,568	209	9,820
1987	129	6,898	156	6,541
1988	43	2,551	157	7,614
1989	56	2,219	156	7,700

Fisheries Agency of Japan

Table 2

Estimated catch (MT), effort (No. of tans) and CPUE (kg/tan) on flying squid

TABLE 2 Estimated Catch (MT), effort (No. of tans) and CPUE (Kg/tan) on Flying Squid

Year	Catch	Effort	CPUE
1982	158,760	21,928,768	7.24
1983	215,785	25,224,746	8.55
1984	123,722	29,251,829	4.23
1985	197,834	34,023,355	5.81
1986	152,230	36,367,294	4.19
1987	208,448	32,063,760	6.50
1988	157,772	36,027,931	4.38

Data from Anonymous MS.

Table 3

North Pacific albacore landings (metric tons)

	Japan					Taiwan	U. S.				Canada	N.Amer Total	Grand Total
	Baitboat	Longline	Gill net	Other	Total		Baitboat	Jigboat	Sport	Total			
1952	41786	26687	-	237	68710	-	-	23843	1373	25216	71	25287	93997
1953	32921	27777	-	132	60830	-	-	15740	171	15911	5	15917	76746
1954	28069	20958	-	38	49065	-	-	12246	147	12393	-	12393	61458
1955	24236	16277	-	136	40649	-	-	13264	577	13841	-	13841	54490
1956	42810	14341	-	57	57208	-	-	18751	482	19233	17	19250	76458
1957	49500	21053	-	151	70704	-	-	21165	304	21469	8	21477	92181
1958	22175	18432	-	124	40731	-	-	14855	48	14903	74	14977	55708
1959	14252	15802	-	67	30121	-	-	20990	-	20990	212	21202	51323
1960	25156	17369	-	76	42601	-	-	20100	557	20657	5	20662	63263
1961	18636	17437	-	268	36341	-	2837	12061	1355	16253	4	16257	52598
1962	8729	15764	-	191	24684	-	1085	19760	1681	22526	1	22526	47211
1963	26420	13464	-	218	40102	-	2432	25147	1161	28740	5	28749	68847
1964	23858	15458	-	319	39635	26	3411	18392	824	22627	3	22630	62291
1965	41491	13701	-	121	55313	16	417	16545	731	17693	15	17708	73037
1966	22830	25050	-	585	48465	16	1600	15342	588	17530	44	17574	66055
1967	30481	28869	-	520	59870	17	4113	17826	707	22646	161	22807	82694
1968	16597	23961	-	1109	41667	15	4906	20444	951	26301	1028	27329	69011
1969	32107	18006	-	1480	51593	21	2996	18839	358	22193	1365	23558	75172
1970	24376	15372	-	956	40704	23	4416	21041	822	26279	354	26633	67360
1971	53198	11035	-	1262	65495	24	2071	20537	1175	23783	1587	25370	90889
1972	60762	12649	1	921	74333	25	3750	23608	637	27995	3558	31553	105911
1973	69811	16059	39	1883	87792	35	2236	15667	84	17987	1270	19257	107084
1974	73576	13053	224	1065	87918	40	4777	20187	94	25058	1207	26265	114223
1975	52157	10060	166	402	62785	28	3243	18975	640	22858	101	22959	85772
1976	85336	15896	1070	1394	103696	37	2700	15932	713	19345	252	19597	123330
1977	31934	15737	688	1039	49398	61	1497	10005	537	12039	53	12092	62051
1978	59877	13061	4029	3209	80176	53	950	16682	810	18442	23	18465	98694
1979	44662	14249	2856	1280	63047	81	303	6801	74	7178	521	7699	70827
1980	46743	14743	2986	1516	65988	-	382	7574	168	8124	212	8336	74324
1981	27426	18020	10348	956	56753	-	748	12694	195	13637	200	13837	70590
1982	29615	16762	12511	1054	59942	-	425	6661	257	7343	140	7483	67389
1983	21098	15103	6884	471	43556	-	607	9512	87	10206	225	10431	53987
1984	26015	15111	10569	3898	55593	-	832	9576	1427	15563	50	15613	71206
1985	20714	14320	13132	1940	50106	-	872	7059	1176	9107	56	9157	59269
1986	16096	12945	9749	2192	40982	-	309	4834	196	5339	30	5369	46351
1987	19091	14642	7617	1394	42744	-	146	2783	7	3003	104	3107	45851
1988	7000	-	5000	-	-	-	627	4198	64	4889	85	4974	-

Figures for 1987-88 are preliminary.
Japanese catches differ from those used previously and were supplied by the Far Seas Fisheries Research Laboratory.
Japanese gill net figures include North and South Pacific catches

U.S. catches from 1961 to 1985 include Hawaii.
U.S. total for 1984 include 3,728 MT caught by purse seine.
U. S. jigboat catches for years 1952-60 include fish caught by baitboat.

NB: Baitboat = pole-and-line; jigboat = troll

Data from Anonymous b (1989)

Table 4-1

Surface fishery catch (mt) of South Pacific albacore by country and gear. (Estimates are shown in parentheses)

YEAR	Australia p/l & sport	Japan gillnet	Korean gillnet	New Zealand troll	Taiwan gillnet	USA troll	TOTAL
1970	(500)						(500)
1971	(500)						(500)
1972	(500)						(500)
1973	(500)						(500)
1974	(500)			898			(1,400)
1975	(500)	?		646			(1,100)
1976	(500)	?		25			(500)
1977	(500)	?		621			(1,100)
1978	(500)	?		1,686			(2,200)
1979	(500)	?		814			(1,300)
1980	(500)	?		1,468			(2,000)
1981	(500)	?		2,085			(2,600)
1982	(500)	?		2,434			(2,900)
1983	(500)	?		744			(1,200)
1984	(200-400)	1,563		2,773			(4,600)
1985	(200-400)	1,905		3,253			(5,500)
1986	(200-400)	1,919		1,911		100	(4,200)
1987	(200-400)	587		1,227		750	(2,900)
1988	(200-400)	4,801		330	1,000	3,600	(10,000)
1989	(200-400)	(7-10,000)	184	5,161	(18-39,000)	(3,700)	(34-59,000)

NOTES

1. Japan 1984-88 figures are rough estimates obtained from interview of a small sample of vessels (SPAR 2/WP.5); 1989 figure is a rough estimate obtained by interview of fishermen.

2. New Zealand 1989 figure is preliminary catch and includes catch of three vessels that fished offshore, outside the EEZ.

3. Taiwan figures are preliminary catch (SPAR 2/WP.6). Estimate for 1989 based on catch rate of 300 mt/vessel for 60-130 vessels.

4. USA troll catches include small amounts caught by Canadian, French Polynesian and Fijian troll vessels.

5. All Australian catches are rough estimates. The 1989 catch is assumed to be the same as for 1988 (SPAR 2/WP.4).

6. Troll and gillnet figures are for the year in which the season finished e.g. the 1988 line is for the 1987/88 season.

7. The Korean gillnet figure for 1989 includes 112 mt taken by purse seiners.

Data from Anonymous a (1989)

Table 4-2

Longline fishery catch (mt) of South Pacific albacore by country. (Estimates are shown in parentheses)

YEAR	Australia	Japan	Korea	New Caledonia	Taiwan	Tonga	TOTAL
1952		210					210
1953		1,091					1,091
1954		10,200					10,200
1955		8,420					8,420
1956		6,220					6,220
1957		9,764					9,764
1958		21,558	146				21,704
1959		19,344	456				19,800
1960		23,756	610				24,366
1961		25,628	330				25,958
1962		38,880	599				39,479
1963		33,500	1,367				34,867
1964		21,435	2,911				24,346
1965		19,305	6,405				25,710
1966		23,401	10,817				34,218
1967		16,640	13,717		11,751		42,108
1968		7,707	10,138		12,424		30,269
1969		5,559	9,963		9,595		25,117
1970		6,560	11,599		14,689		32,848
1971		4,339	14,482		15,887		34,708
1972		2,796	14,439		(16,814)		(34,049)
1973		2,381	17,452		17,742		37,575
1974		1,847	12,194		17,283		31,324
1975		1,045	9,015		17,071		27,131
1976		1,906	12,212		13,700		27,818
1977		2,240	13,176		21,932		37,348
1978		2,520	10,989		20,942		34,451
1979		2,350	8,682		15,086		26,118
1980		2,488	10,852		18,180		31,520
1981		4,856	14,793		14,595		34,244
1982		4,900	12,586		12,689		30,175
1983		4,928	6,669		12,119		23,716
1984		3,607	5,730		11,155		20,492
1985		3,746	14,267		9,601		27,614
1986	15	4,466	18,799	185	11,913	166	35,544
1987	94	4,085	8,646	563	15,009	227	28,624
1988	78	(4,100)	6,896	567	17,120	212	(28,973)

NOTES

1. Japan estimate for 1988 is the average of 1985-1987 catches (SPAR 2/WP.10).

2. Taiwan data source is landings stated by Taiwan Deepsea Tuna Boatowners and Exporters Association.

3. The 1972 Taiwanese catch is estimated as the average of the 1971 and 1973 catches.

Data from Anonymous a (1989)

Table 5 Catch (10^3 ton), Fishing intensity (10^4 effective hooks/5° square) and CPUE on the north Pacific striped marlin stock, 1970-1985.

	Japanese Catch			Fishing Intensity		
	Longline	Large-mesh Driftnet	ALL Fisheries	Japanese Longline	ALL Fisheries	CPUE× 10^{-1} Longline
1970	12.1	0	18.3	82.6	124.6	1.46
71	9.6	0	17.4	71.3	128.8	1.35
72	6.1	0.2	8.9	70.5	103.0	0.87
73	6.0	3.3	11.5	82.1	156.2	0.73
74	6.1	3.1	10.9	75.8	136.1	0.80
75	4.3	6.5	12.4	51.7	150.4	0.83
76	5.0	3.6	9.6	70.1	133.9	0.71
77	2.0	4.4	8.8	42.3	190.2	0.47
78	1.9	5.6	9.7	50.8	255.3	0.37
79	3.8	2.5	8.4	56.5	125.5	0.67
1980	5.4	3.5	11.1	51.0	106.1	1.06
81	3.6	3.9	9.2	53.8	137.3	0.67
82	4.7	2.4	8.7	57.1	105.0	0.45
83	2.9	1.9	6.8	50.1	116.3	0.58
84	3.1	2.3	8.0	46.1	120.7	0.67
85	3.1	2.4	8.1	39.6	103.0	0.78

Modified from Suzuki (1989)
Japanese Large-mesh driftnet catches from Y. Watanabe (personal comm.)

APPENDIX I

Review of Research and of Recent Developments in South Pacific Albacore Fisheries with Emphasis on Large-Scale Pelagic Driftnet Fishing

By

Talbot Murray

INTRODUCTION

Large-scale pelagic driftnet fishing has been widely used in the South Pacific region since 1983, especially in the Tasman Sea east of Australia and the area east of New Zealand. Most driftnet fishing, however, has been experimental, involving relatively few vessels to assess the commercial potential of undeveloped and underdeveloped resources in high seas areas. The commercial potential of a wide variety of pelagic resources have thus far been assessed but access to results of driftnet surveys is extremely difficult. Taiwanese driftnet surveys, conducted largely within Australian and New Zealand waters, for squid (Ommastrephes bartrami and Nototodarus gouldi) in 1981 have been described by Collins and Dunning 1981 and Anon 1981. Large-scale pelagic driftnet fishing by Taiwanese vessels for sharks and mackerel began in 1974 in the waters of the adjacent Arafura Sea north of Australia and is the most extensively studied driftnet fishery in the region. This fishery was closed in 1986 because of the high catch of dolphins (Read and Ward 1986) based on the work of Harwood et al. (1984), Harwood and Hembree (1987), and Hembree and Harwood (1987). The results of JAMARC driftnet surveys for slender tuna (Allothunnus fallai) since 1983; for pomfrets (three species of Bramidae) since 1984; and for albacore (Thunnus alalunga) since at least 1987 are not readily available.

More recently the rapid development of South Pacific albacore surface fisheries, particularly the driftnet fishery, has raised considerable concern over the potential impacts to the stock and to some components of the incidental catch. The absence of requirements for commercial fishing vessels to provide catch and effort data (changed only in the 1989/90 season for Japanese vessels) and the lack of access to driftnet survey data on catch rates, catch composition, and size composition of target species has severely hampered the assessment of large-scale pelagic driftnet fishing for albacore in the South Pacific.

In order to understand the concerns caused by the expansion of large-scale pelagic driftnet fishing in the South Pacific it is necessary to review both the development of South Pacific albacore fisheries and the research which has been carried out on the stock. From this framework it is also easy to identify research areas that will need to be further developed.

DEVELOPMENT OF SOUTH PACIFIC ALBACORE FISHERIES

Longline Fisheries

South Pacific albacore fisheries began with the expansion of Japans' distant water longline fleet into the South Pacific during the early 1950s. Longliners from the Republic of Korea, following the early success of the Japanese fleet, began targeting albacore in the late 1950s and were followed by longliners from Taiwan in the late 1960s. Since 1985, South Pacific coastal states have also begun fishing for adult albacore. Tonga and New Caledonia have both invested in longliners which solely target albacore and a number of small vessels drop line for adult albacore in French Polynesian waters.

The combined catch by all fleets targeting adult albacore has been at or below the estimated Maximum Sustainable Yield (MSY) of 30-35,000 tonnes (Wang et al. 1988) since the late 1970s. This paper ignores catches in all fisheries other than the asian longline fishery on the basis that these fisheries account for over 90% of all catches. Table 1 summarizes South Pacific longline catches of albacore.

Surface Fisheries

Trolling for albacore first developed in the South Pacific in New Zealand coastal waters in the late 1960s. This fishery experiences extremely variable landings due to uncertain weather conditions during the short summer season and due to variable climatic effects on the southern extent of the juvenile albacore distribution. In good seasons (warm calm summers) over 200 small vessels may enter this fishery and can be expected to land 2000-4000 tonnes of juvenile albacore. In bad seasons (cold windy summers) fewer vessels fish and landings can be expected to be less than 1000 tonnes. The troll fishery has expanded since 1986, partly due to perceptions that observed declines in longline fishing might allow increased yields from the surface fishery and partly from results of exploratory fishing along the Subtropical Convergence Zone (STCZ) east of New Zealand. The STCZ albacore troll fishery has continued to develop from 100 tonnes and two vessels in 1985/86 to about 4000 tonnes and 50 vessels in 1988/89.

During the same period that the STCZ troll fishery was developing east of New Zealand, a large-scale pelagic driftnet fishery for albacore was also developing in high seas areas east and west of New Zealand. The rapid expansion of this driftnet fishery from 10 vessels in 1986/87 to perhaps as many as 198 in 1988/89 and the magnitude of driftnet catches (estimated conservatively) resulted in considerable concern amongst coastal states of the region over the sustainability of continued harvests of juveniles at 1988/89 levels. Table 2 summarizes the catches in surface albacore fisheries in the South Pacific by country and fishing method.

Table 1

Longline catches (tonnes) of South Pacific albacore by country waters. Asterisks indicate estimated catches

Year	Japan	Korea	Taiwan	Others	Total
1952	210				210
1953	1,091				1,091
1954	10,200				10,200
1955	8,420				8,420
1956	6,220				6,220
1957	9,764				9,764
1958	21,558	146			21,704
1959	19,344	456			19,800
1960	23,756	610			24,366
1961	25,628	330			25,958
1962	38,880	599			39,479
1963	33,500	1,367			34,867
1964	21,435	2,911			24,346
1965	19,305	6,405			25,710
1966	23,401	10,817			34,218
1967	16,640	13,717	11,751		42,108
1968	7,707	10,138	12,424		30,269
1969	5,559	9,963	9,595		25,117
1970	6,560	11,599	14,689		32,848
1971	4,339	14,482	15,887		34,708
1972	2,796	14,439	16,814*		34,049*
1973	2,381	17,452	17,742		37,575
1974	1,847	12,194	17,283		31,324
1975	1,045	9,015	17,071		27,131
1976	1,906	12,212	13,700		27,818
1977	2,240	13,176	21,932		37,348
1978	2,520	10,989	20,942		34,451
1979	2,350	8,682	15,086		26,118
1980	2,488	10,852	18,180		31,520
1981	4,856	14,793	14,595		34,244
1982	4,900	12,586	12,689		30,175
1983	4,928	6,669	12,119		23,716
1984	3,607	5,730	11,155		20,492
1985	3,746	14,267	9,601	n/a	27,614
1986	4,466	18,799	11,913	200	35,378
1987	4,085	8,646	15,009	884	28,624
1988	4,100*	6,896	17,120	866	28,982*

Table 2

Surface fishery catches (tonnes) of South Pacific albacore since 1970 by country and gear. Asterisks indicate estimated catch

Year	Australia Various*	Total Gillnet*	N Z Troll	STCZ Troll	Total*
1967	n/a		5		5
1968	n/a		14		14
1969	n/a		n/a		n/a
1970	500		50		550
1971	500		n/a		500
1972	500		268		768
1973	500		484		984
1974	500		898		1,400
1975	500		646		1,100
1976	500		25		500
1977	500		621		1,100
1978	500		1,686		2,200
1979	500		814		1,300
1980	500		1,468		2,000
1981	500		2,085		2,600
1982	500	?	2,434		2,900
1983	500	?	744		1,200
1984	200-400	1,563	2,773		4,600
1985	200-400	1,905	3,253		5,500
1986	200-400	1,919	1,911	100	4,200
1987	200-400	587	1,227	750	2,900
1988	200-400	5,801	330	3,600	10,000
1989	200-400	25-49,000	4,801	4,100*	34-59,000

In addition to concerns of overfishing, albacore catch levels by driftnet fleets have raised concern related to the potential for economic impacts which could range from diminished landings at regional canneries, reduced catches in regional fisheries, loss of fisheries development opportunities, reductions in foreign longline catches with resultant effects on regional support bases and fishing license fees. Concern over direct competition between driftnet and troll fleets also arises since both surface fisheries catch the same sizes of fish in the same area at the same time.

The rapid development of the driftnet fishery without adequate information on the population dynamics of South Pacific albacore and without collecting fisheries statistics from this fleet has made impact assessment extremely difficult. However, the reductions in driftnet fleet size in 1989/90 and the commitment to stop driftnet fishing by July 1991 must reduce the threat posed by the 1988/89 catch levels and increase confidence that it will be possible to manage the resource effectively.

ALBACORE RESEARCH PROGRAMMES IN THE SOUTH PACIFIC

The general features of the biology, ecology, and distribution of Pacific albacore are well known (Foreman 1980). It is clear from this synopsis that there are differences in fisheries operating on the stocks and in the population structure of albacore stocks between the North and South Pacific and that less is known about the South Pacific stock.

The distribution of the South Pacific albacore stock is imprecisely known from egg and larval surveys (Nishikawa et al. 1985), research surveys for juveniles (Roberts 1977 and 1980; Ichikawa 1981; Iwasa et al. 1982; Le Gall et al. 1982; Laurs et al. 1986 and 1987; Murray and Bailey 1987; Watanabe et al. 1989), and historical catch and effort data from commercial fisheries (Foreman 1980; Polacheck 1987; Wang 1988). Based on these sources the approximate geographical limits for the South Pacific stock are believed to extend from the equator to 50° S and from the east coast of Australia to the west coast of South America. At present there no information which demonstrates that there is more than one albacore stock in the South Pacific. However, the possibility of mixing between stocks, either between the South Pacific and Indian Oceans around southern Australia or between the North and South Pacific has not been ruled out.

AN OVERVIEW OF NEW ZEALAND ALBACORE RESEARCH PROGRAMMES

South Pacific Albacore Research linkages

New Zealand MAF Fisheries has maintained an active field research programme to study the distribution, growth, and movement of albacore in the southwestern Pacific since 1984. This research has been closely integrated with other research programmes on the South Pacific stock through the South Pacific Albacore Research (SPAR) group. Research planning has also been done in consultation with the SPAR group. Where possible joint programmes have been developed (e.g., a scientific observer programme with the SPC, development of ageing techniques with the U.S. National Marine Fisheries Service, a tagging programme with SPC, NMFS, and France). Continuation of an active research programme to provide data for stock assessment (including driftnet impacts) and which is integrated with other research initiatives in the South Pacific is planned.

Observer Programmes

Observers have been placed on troll vessels during the 1988/89 and 1989/90 seasons to assess the size composition of the troll catch, hook drop off rates, catch composition, catch rates, and the incidence of recent versus old driftnet damage. The results are to be published annually by the SPC.

In the 1989/90 season an observer was allowed to board the JAMARC research driftnet vessel Shin-hoyo maru for one month in the Tasman Sea and for one month south of Tahiti. The activities of the observer were similar to those of observers on troll vessels. The results of this work will be jointly published.

A small observer programme is also conducted onboard longline vessels fishing within the New Zealand EEZ. This programme ensures that the size composition of adult albacore are censused annually.

Research Surveys

Research surveys to assess catch rate and size composition of troll caught albacore in relation to oceanography are conducted annually. These surveys have provided data on relative abundance of albacore in high seas areas relative to shelf-slope areas fished by the New Zealand domestic fleet.

Research surveys to assess the frequency of recent driftnet damaged albacore in relation to the geographical distribution of the driftnet fleet are being conducted to determine patterns of short-term movement.

Commercial Catch Sampling

Port and vessel sampling of the New Zealand albacore catch is conducted several times each year during the summer season to provide a regular series of length frequencies. The incidence of driftnet damage is also estimated onboard troll vessels.

Tagging Studies

Tagging is conducted annually during dedicated research cruises east and west of New Zealand as part of a regional study of movements coordinated by SPC. The majority of albacore are also injected with oxytetracycline as part of an age validation experiment.

Age Determination

A rapid method for age determination is being evaluated by comparing the banding sequences in caudal centra with those in otoliths. The banding sequence in caudal centra appears to provide a rapid method for ageing albacore up to 10 years old. Studies are currently underway to try and decrease the variance in the fitted growth curve by stratifying samples by sex. The validation of this method is part of a joint study with U.S. scientists and has been underway for several years awaiting recoveries of whole oxytetracycline injected tagged fish.

Biological Studies

Ancillary studies have also been carried out on albacore forage items (Bailey and Habib 1982, Bailey 1987), on albacore

parasites (Jones 1987, 1989), proximate composition (Vlieg and Murray 1988), and on albacore maturation (Ross 1987). These studies are a by-product of major albacore programme and are helping to increase our understanding of South Pacific albacore.

RESULTS OF SOUTH PACIFIC ALBACORE RESEARCH

Albacore studies undertaken by New Zealand and others in the South Pacific provides a reasonable basis for understanding the nature of albacore fisheries and which portions of the stock they operate on. The information which recent research has provided is discussed below while the information which still largely remains to be gathered is identified in a later section.

Fleet Composition, Seasonality and Areas of Operation

The number of vessels by gear type and nationality is given in Table 3 for South Pacific albacore surface and longline fisheries. In many cases the number of vessels represents only a rough estimate of what may be a larger fleet. Surface fisheries, targeting juvenile albacore in the surface mixed layer, have a limited fishing season corresponding to the austral summer months of December to March. Surface fisheries are further restricted to a relatively narrow latitudinal band between approximately 37 and 41° S during this period and extend from the Australian coast eastwards to approximately 130° W. Longline fisheries in contrast, target deeper dwelling adult albacore and operate throughout the year moving southwards from the equator between February and August and then contracting equatorward from September to January. According to Wang et al. (1988) fishing concentrates north of 20° S from October through March and is broadly distributed as far south as 40° S in other months with most fishing south of 20° S from May to July. This results in a seasonal segregation of surface and longline fisheries.

Table 3

Fleet size for countries fishing for albacore in the South Pacific during the period 1987-1989 by fishery. Estimated vessel numbers are enclosed in parentheses. Information from (SPC 1989) and other sources.

Surface Fisheries	1986/87	1987/88	1988/89
Australia, pole-and-line	?	?	?
Japan, driftnet	(9)	(20)	67
Korea, driftnet	0	1	1
New Zealand, troll	(100)	(25)	(200)
Taiwan, driftnet	0	7	(60-130)
U.S., troll	7	43	48

Longline Fishery	1987	1988	1989
Australia	47	27	?
Japan (minimum no.)	307	344	?
Korea (minimum no.)	99	90	?
New Caledonia	3	3-4	3-4
Taiwan	53	63	(75)
Tonga	1	1	1

CPUE Trends

Three sets of CPUE time series are readily available and reviewed in SPC (1989). They are the U.S. troll (Laurs and Nishimoto 1989), Japanese driftnet (Hideki et al. 1989) and longline fisheries (Wetherall and Yong 1989, Wang et al. 1988). In modelling the longline fisheries Wang et al. (1988) used effective effort and Wetherall and Yong (1989) used nominal effort for CPUE calculations.

Two sets of surface fisheries CPUE estimates are shown in Table 4, one for the U.S. troll, the other for the Japanese driftnet fishery. These fisheries show decreasing and increasing trends, respectively, for the period 1986/87 to 1988/89 and for the period 1983/84 to 1987/88.

Table 4

CPUE trends in South Pacific albacore surface fisheries

Year	U.S. Troll Vessel Catch (no. fish per vessel day)	Japanese Driftnet Vessel Catch (no. fish per vessel day)
1983/84		253.3
1984/85		452.0
1985/86		516.6
1986/87	330.2	473.9
1987/88	303.8	937.0
1988/89	283.3	

The increasing trend of CPUE for the Japanese driftnet fishery appears to reflect a shift of fishing effort towards the peak of the season rather than a change in abundance. The shortness of the time series makes the apparent discrepancy between surface fisheries difficult to interpret.

The longline CPUE for the entire South Pacific albacore stock based on effective effort showed a moderate decreasing trend to about one half from 1971 to 1985 (Wang et al. 1988). The set of annual longline CPUE based on nominal effort for the area between 35 and 40° S, over all longitudes, was calculated from the early 1970s to 1989, stratified by month. No consistent decreasing or increasing trends were observed for April data, while the series for May showed a decreasing trend, especially marked from 1986 to 1989 (Wetherall and Yong 1989). However, it is not possible to give an unequivocal single explanation for this sharp drop due to preliminary nature of 1988 and 1989 data.

Size Composition of the Catch

The size compositions of commercial albacore troll catches from the Tasman Sea and east coast of New Zealand are shown in

Figure 1. Albacore in the Tasman Sea ranged in size from 44-91 cm. fork length with three equal modes at 56-57 cm, 67-68 cm, and at 76 cm. Along the east coast of the North Island albacore ranged in size from 41-98 cm with slight (about 1 cm) shifts to the right in the three modes. The modes in the east coast fishing area were at 55-56 cm, 66-68 cm, and at 74-75 cm. Differences between fishing areas and changes in size composition throughout a fishing season are well known. However, the differences between fishing areas is not consistent with the general pattern within the New Zealand EEZ of larger fish on the east coast of the North Island than in the Tasman Sea.

The size composition of the albacore catch by the research driftnet vessel operating in the Tasman Sea reported by the SPC/NZ observer is compared with troll vessel catch in Table 4. Despite the area differences in the troll catch it is clear from Table 4 that both driftnet and troll vessels catch similar sized fish primarily intermediate and large size juveniles.

Table 5

Albacore fork length modes in troll and driftnet fisheries operating in the western South Pacific in the 1989/90 fishing seasons

Fishery	Small	Intermediate	Large
Tasman Sea Troll	56-57 cm	67-68 cm	76 cm
east coast NZ Troll	55-56 cm	66-68 cm	74-75 cm
STCZ Troll	?	67 cm	75-76 cm
Tasman Sea Driftnet	59-61 cm	66-67 cm	74-76 cm

The 59-61 cm mode in the driftnet fishery in 1989/90 was also present in last years catch but is much reduced this year. The difference between fisheries with regard to the small size classes may be due to a combination of mesh size selectivity and differences in the proportions of small fish recruiting to different parts of the western South Pacific early in the season.

A total of 12,364 fish have been measured during the first segment (January-March 1990) of an observer cruise on troll vessels east of New Zealand along the STCZ, 8.3% of these were smaller than 58 cm and 0.2% were larger than 90 cm. None of these small or large size classes contained fish with old driftnet marks. Old driftnet marks were confined to fish between 63 cm and 87 cm in size.

The size composition of the 1989/90 STCZ troll catch is contrasted with the same period in 1988/89 in Figure 2. The troll catch exhibits clear modes at 67 cm and at 75-76 cm, the lesser mode is less well characterized because of the aggregation of small size classes but is likely to be at about 58 cm. This size composition is very similar to that of troll catches in the Tasman Sea and along the east coast of New Zealand this season. The albacore

which showed old driftnet damage exhibited modes which coincide with the intermediate and large size classes in the troll catch. Compared with troll catches during the same period last year (1988/89 season) the modes are at approximately the same sizes but the relative magnitude of small, intermediate, and large size classes are quite different. This year there appears to be a reduction in the small size classes and an apparent increase in the relative abundance of larger albacore. This pattern is also evident in the size frequency distribution of albacore with old driftnet marks seen this year.

Catch Composition in South Pacific Albacore Fisheries

It is readily acknowledged that in all fisheries there is an incidental or by-catch of other species. It is also recognized that the extent to which by-catch must be considered in managing a fishery depends on how selective the fishing method is and on the vulnerability of species associated with the target species.

Three very different fishing methods are used in the South Pacific to target albacore. The large-scale pelagic driftnet fishery sets its gear in the top 10-15 m at night when juvenile albacore and associated species are feeding at or near the surface. The troll fishery operates from pre-dawn to just after dark drawing juvenile albacore to the surface from as deep as 70 m using artificial lures which imitate small fish. Longliners set baited hooks for deeper dwelling adult albacore from droplines along a submerged mainline at depths of 100-300 m (Suzuki et al. 1977), although albacore can be caught by longline from 50-500 m (Grandperrin and Le Guen 1986).

In order to demonstrate the relative selectivity of the three major target fisheries for South Pacific albacore I have compiled estimates of catch composition for the driftnet fishery (based on research survey catch reports) in Table 6, for the longline fishery in Table 7, and for the troll fishery in Table 8. For the driftnet and longline fisheries the non-fish by-catch (marine mammals, sea birds, and turtles) which is known to occur, although to a much greater extent in the driftnet fishery than the longline fishery, has not been recorded. The troll fishery statistics represents the total catch of all species based on observer data. It is immediately apparent that trolling as a method is the most selective of the currently practised fishing methods followed by longlining. Driftnet fishing even based solely on fish by-catch is clearly the least selective of all oceanic pelagic fishing methods.

Table 6

Catch composition as percent by weight reported by Japanese driftnet research vessels in the South Pacific, data from Watanabe et al. (1989)

	albacore target	slender tuna target	pomfret target
albacore	20.0	4.5	2.7
skipjack	1.6	1.4	0.6
yellowfin tuna	0.2	0.1	< 0.1
slender tuna	42.5	70.5	54.1
other tunas	0.3	0.6	0.8
billfish	7.7	2.4	0.4
sharks	26.1	11.0	14.2
pomfrets	0.4	8.1	26.4
squids	0.8	0.4	0.2
other fish	0.4	0.9	0.6
% target	20.0	70.5	26.4
% non-target	80.0	29.5	73.6
total tonnes	188.4	1453.9	1822.4
total tans set	60104	218798	237618
years fished	87/88	82/83-86/87	84/85-86/87

Table 7

Catch composition (as percentage by weight) of albacore longline fisheries operating within the N.Z. EEZ

	Japan	Korea
albacore	31.4	81.7
bigeye tuna	22.0	6.4
butterfly tuna	<0.1	14.9
no. bluefin tuna	0.1	<0.1
so. bluefin tuna	0.3	0.0
yellowfin tuna	8.0	5.3
swordfish	19.3	0.7
black marlin	0.2	1.1
blue marlin	0.2	1.3
striped marlin	9.4	0.7
sailfish	<0.1	0.1
spearfish	0.1	<0.1
sharks	9.1	2.7
% target	31.4	81.7
% non-target	68.6	18.3
total tonnes	562202	3437324
years fished	1985-1988	1981-1988

Table 8

Catch composition (as number caught) in the albacore troll fishery in the southwestern South Pacific

	Daniel Solander Nov/Dec 1989	Kariqa Nov/Dec 1989
albacore	4499	2270
skipjack tuna	19	71
yellowfin tuna	15	6
yellowtail kingfish	0	10

It may be possible to minimize the non-fish by-catch in these fisheries. Japanese longliners operating within New Zealand waters often employ a line of artificial squid lures without hooks above the longline as it is being baited and set. The lures tend to scare away the sea birds when they dive on the baited hooks thus reducing the by-catch of seabirds. Marine mammals are only occasionally caught on longlines and it is not clear how it could be lowered. In the driftnet fishery this year JAMARC regularly tried an experimental net deployment at 2 m below the surface. These experimental driftnets are reported to have had the same catch rates for albacore but significantly lower catches of skipjack. In particular, no marine mammals, sea birds or turtles were caught in the nets set 2m below the surface. Unfortunately it is not clear whether this experiment is representative of the commercial fleet since the research driftnet vessel did not fish in the same areas at the same times as the other driftnet vessels. It is also unclear why subsurface deployments have not been carried out in the commercial fleet since they have been used by other JAMARC driftnet cruises in the South Pacific in the past (e.g., Ibaraki Maru during January-February 1987).

In Australian experiments with modified driftnets conducted in 1984-1986 (Hembree and Harwood 1987) setting driftnets below the surface reduced the marine mammal by-catch by 50% but also reduced the target species (shark and mackerel) catch by up to 25%. Other experiments by Hembree and Harwood (1987) to increase the accostic target strength of the driftnets with metallic beaded chains and air filled plastic tubes did not reduce the marine mammal by-catch of the driftnets.

In monitoring the catches of fisheries one of the easiest ways of assessing by-catch is with an appropriately designed catch and effort form. These forms usually are restricted in their scope to commercial fish species. At present the only data routinely collected in the South Pacific is from the Japanese longline fleet wherever it fishes, all fisheries operating within Exclusive Economic Zones (primarily through the SPC), and beginning in 1989/90 from the Japanese driftnet fishery. The U.S. high seas troll fishery, the Taiwanese and Korean longline fisheries are covered less well with a voluntary catch and effort form. The data supplied through all of these schemes suffer to varying degrees from error. From independant observer verification of catch and effort accuracy in New Zealand waters we have found that generally the less valuable the species the greater the under-reporting error. We have also determined that only the fish which are landed are recorded, fish which are caught but discarded are not recorded.

The only way to surmount the problem of non-reporting of discards and under-reporting of lesser valued species is through an observer programme. An observer programme is also the only means of assessing non-fish by-catch problems.

Driftnet Dropout Rates of Albacore

One point of concern in assessing the impact of driftnet fishing on the target species is incidental mortality which is not reflected in the nominal catch estimates currently available. There are two components to incidental mortality, one resulting from escapement and another due to fish dropping out of the net during hauling (termed dropout rate). We know from the observer programme that escapement is high (Hampton et al. 1989) but estimates of driftnet damage in the troll catch only reflects the portion of driftnet escapees which survive. We have as yet been unable to devise a method for estimating incidental mortality due to escapement. On the otherhand it has been simple to estimate the dropout rate of dead albacore during a series of driftnet hauling operations. This work has been done separately by both Japanese and SPC scientists. Based on independent visual counts by the two scientists, the dropout rate of dead albacore during hauling was estimated to be approximately 7 to 9 percent. Data on dropout of dead albacore from driftnets while soaking were not collected nor has it yet been possible to determine if dropout rate is higher during rough weather as might be expected.

Interactions Between South Pacific Albacore Fisheries

The nature of interactions between South Pacific albacore fisheries is presently known in qualitative terms from data collected by scientific observers and from New Zealand research cruises. Size composition of albacore in driftnet, troll and longline fisheries together with the incidence of recent driftnet damage in the troll catch has been described in Hampton et al. (1989). These data show clearly that interactions between troll and driftnet fisheries and between combined surface and longline fisheries exist for some size classes. In particular, in the troll catch in 1988/89 the incidence of recent driftnet damage varied from 3% to 30% on individual days where reasonable numbers of fish were caught. Few fish smaller than 60 cm fork length or larger than 70 cm were driftnet marked although substantial numbers of albacore in these size classes were caught by trolling. The high incidence of net marks in 60-75 cm albacore suggests that escapement is high. The observation that the size composition of both troll and driftnet catches is the same and that troll and driftnet vessels fish the same areas at the same time indicates that interaction is likely to be high. Since most driftnet escapement is of fish 60-75 cm fork length suggests that fisheries interactions may be especially intense for intermediate sized juveniles.

In addition, approximately 25% of albacore in the size range 60-75 cm fork length caught in the longline fishery off New Zealand last June were net marked. This observation clearly suggests that albacore in this size range are available to all fisheries and hence interactions between all three fisheries probably occurs. It also suggests that effects of large surface catches may be detected in the longline fishery with a relatively short time lag.

The incidence of driftnet damaged fish in research troll survey catches this year was found to decrease rapidly with increasing distance from the area of driftnet fishing activity in the Tasman Sea this year. The geographical pattern of recent net marked albacore was consistent with the hypothesis that albacore in the western Tasman Sea at mid-latitudes (38° to 41° S) move eastwards towards New Zealand during early summer. The observed increase in net marked albacore in commercial catches from 0.5% to 3.0% between late December 1989 and early March 1990 suggests that the effects of driftnet fishing on troll catches reported by Hampton et al. (1989) may extend to fisheries operating over 1000 km apart.

PRELIMINARY RESEARCH RESULTS FROM THE 1989/90 SEASON

Since the First Consultation on Arrangements for South Pacific Albacore Fisheries Management held in Wellington in November 1989, additional information has been collected. A research cruise was undertaken by the Japan Marine Fishery Resource Research Center (JAMARC) research driftnet vessel Shin-hoyo Maru. The results of leg 1 of the cruise (Tasman Sea area) have been discussed among scientists attending the Second Consultation on Arrangements for South Pacific Albacore Fisheries Management held in Honiara, Solomon Islands 28 February to 7 March 1990. The results of leg 2 (in the Sub-tropical Convergence Zone east of New Zealand) will be available for the next consultation scheduled for Noumea, New Caledonia in October.

The preliminary findings of leg 1, as reported by both the Japanese and SPC scientists were as follows:

- Based on independent visual counts by the two scientists, the dropout rate of dead albacore during hauling was estimated to be approximately 7 to 9 percent. Data on dropout of dead albacore from driftnets while soaking were not collected.

- Relatively few small albacore (<65cm) were caught during the cruise compared with observed sizes of albacore caught by the commercial Japanese fleet operating in the same area last year. The average albacore catch was 293 fish per set.

- The fish catch other than albacore was comprised primarily of skipjack (353 per set) and pomfret (331 per set). On average 2.3 common dolphins and 0.5 striped dolphins per set were incidently taken. In addition, one pilot whale, one southern bottlenose whale and two unidentified whales were incidentally taken during the cruise. Three leatherback turtles were caught, but were all released in healthy condition. Seabird mortality (four) was minor.

- Experiments were conducted by JAMARC in which one net from most sets was suspended 2m below the surface. There was no difference in the albacore catch between the experimental and commercially deployed nets. However, the by-catch was substantially reduced in the experimental net. In particular, no marine mammals, turtles or seabirds were caught in the

experimental nets. Although this method appears to be effective in reducing by-catch, further trials are desirable to ensure the results obtained are representative of commercial driftnet operations.

A research cruise to the Tasman Sea was conducted by New Zealand MAF Fisheries on the FRV Kaharoa from late December 1989 to mid January 1990. The purposes of the cruise were to estimate the incidence of recent driftnet damage in albacore caught by trolling; map the distribution of recent driftnet damaged albacore in relation to the area fished by the driftnet fleet; determine the size composition and troll catch rate of albacore in the central and western Tasman Sea at mid-latitudes in early summer.

The main findings include:

- incidence of driftnet damage for the entire cruise was about 27%. No driftnet damage was observed in catches west of the area fished by the driftnet fleet.

- the geographical distribution of driftnet damage is consistent with the hypothesis that albacore move eastwards from western mid-latitude areas of the Tasman Sea during early summer. Further analysis and study of this hypothesis is required;

- troll catch rates were several times higher than those of commercial troll vessels fishing in the eastern Tasman Sea and equivalent to catch rates immediately east of New Zealand;

- results of an observer programme by SPC and MAF Fisheries onboard troll vessels indicate that driftnet damage to fish (when driftnet vessels were not fishing in the same area as troll vessels) had occurred in previous seasons;

- in the eastern Tasman Sea and along the east coast of New Zealand, the incidence of old driftnet damage was 0.5%, further to the east along the Subtropical Convergence Zone, the incidence of old driftnet damage was over 9%;

- no freshly damaged fish were observed east of New Zealand before troll vessels entered the area of driftnet fishing south of French Polynesia in late February;

- length frequency distributions from the Tasman Sea and from areas east of New Zealand relative to last year, show a reduction in smaller size classes and an increase in larger size classes.

Recent South Pacific research initiatives, coordinated by the South Pacific Albacore Research (SPAR) group, and the opportunity to place a South Pacific observer onboard a JAMARC research driftnet vessel in 1989/90 has considerably added to the data available to assess the albacore stock and the fisheries operating on it. However, the preliminary nature of the

information available at this time (the first half of the 1989/90 surface fishery season) constrains interpretation of the data at present.

FUTURE RESEARCH NEEDS

Stock Assessment Needs

It is important to identify appropriate methods for South Pacific albacore stock assessment and monitoring, and to specify the corresponding data requirements. Before the recent development of surface fisheries, the status of the traditional longline fishery was adequately assessed with a surplus production model based on the longline catch rates and total catch statistics. It is essential to continue collection of the catch and effort data, but other methods are now needed to assess yield potentials in the surface fisheries and in the aggregate. In particular, age structured and/or size structured methods are needed to analyze the relationships between yield per recruitment and size specific fishing mortality, and to assess impacts of the surface fishery developments. These methods require extensive data on size composition of the catch and means to compute the growth and mortality rates.

Growth rates can be derived from size frequency data, tagging, and studies of hard parts (e.g., otoliths and vertebrae). Mortality rates can be estimated from changes in the size of cohorts over time. The age specific cohort analyses will require estimates of age composition of catches in each fishery. For the longline fishery this will be difficult as age groups are not clearly separated in the catches.

In addition to using cohort models to estimate mortality and recruitment, it would be useful to develop models which account for spatial variation in population abundance and the distribution of fishing effort. These models can be age and/or size specific.

Besides the analytical and empirical models just described, there is a need for numerical simulation models. These would allow assessments and projections to be made under complex sets of assumptions about stock dynamics and exploitation patterns. Indeed, until solid data are available to support the age specific empirical models, the simulations may be the best means of providing provisional assessments. They would also be particularly valuable for evaluating the implications of increasing surface fishery effort, and for assessing the effects of uncertainty in parameter estimates.

Data Requirements

Various data are required for stock assessments of South Pacific albacore in support of management. Data for other purposes (e.g., economic data, fleet composition, vessel location, observer data, etc.) are also necessary for effective fisheries management.

The data for stock assessment purposes may be classified as fisheries data (catch, effort, etc) and data on various biological processes (growth,

mortality, recruitment, etc). Although in some situations more precise data will be needed, minimum requirements for assessments of the South Pacific albacore stock include both fisheries data and biological data.

The fisheries data required include:

- effort and catch by species (including non-target species) for the longline and all surface fisheries in the South Pacific, stratified by 5 degree square and by month;
- size composition of albacore for each gear type, stratified by 5 degrees latitude and 10 degrees longitude areas and by month;
- estimates of incidental mortality (dropout, discards, etc) of albacore associated with all fisheries.

The biological data that are required relate to:

- growth rates
- natural mortality rates
- recruitment
- seasonality of spawning
- stock structure and migration
- distribution in relation to oceanographic features

The collection, early availability, and timely exchange of catch and effort data from all fisheries catching significant numbers of albacore is critical to the success of stock assessment. Delays can interfere with early recognition of fishery trends. For example, changes in longline catch rate or size composition may be the first indicators of population response to changed fishing levels while changes in troll fishery catch rate and size composition may, in the longer term, reflect variability in recruitment. In the short term changes in size composition may be the only indication of the effects of interaction between the troll and gillnet fisheries.

Collection of catch data needs to account for the total albacore removals from the region. In addition, time series of catch rate stratified by area and time for major albacore target fisheries are necessary to monitor abundance trends. Finally, details of catch size composition, by area and time, and for the various fisheries is required.

The most urgently required data are those describing catch, effort, species composition and size composition in the South Pacific driftnet fisheries of Taiwan and Japan. The introduction of data collection procedures for Taiwanese driftnet activity in the South Pacific is of paramount importance because no such collection system exists. Japan introduced mandatory provision of catch and effort information from driftnetters beginning in 1989/90.

Effort should also be made to supplement the collection of catch and effort data from the driftnet fishery with historical data on the fishery. The very recent establishment of the driftnet fishery suggests that scope probably still exists to assemble historical data from current operators. Regardless of the potential difficulties in collecting historical data, the information currently available on large-scale pelagic driftnet fishing in the South Pacific is so sparse that special attention to the matter is warranted. For example, data for the 1988/89 season is limited to two vessels of the estimated 128-198 driftnet vessels that fished during the season. Data availability for the 1989/90 season is presently unknown.

Efforts to improve the collection of size composition data were instituted for the 1989/90 season. Albacore size composition data is generally available from Japanese longliners which target species other than albacore and from Taiwanese and Korean longliners targeting albacore and landing at American Samoa. Albacore size composition data has been collected since the start of each fishery but the size composition of albacore caught by driftnet vessels remains very limited.

At the Second Consultation on Arrangements for South Pacific Albacore Fisheries Management agreement was reached for data to be provided to SPC by all fishing parties in an agreed format. SPC, on behalf of the recently constituted scientific advisory group, will compile all data and make it available for distribution to nominated members of the scientific advisor group on request.

The specific data required now and the time of data submission has been agreed as follows:

- Monthly catch and effort data by 5 degree square will be provided for longline fisheries for each calendar year to be submitted by 30 June, 18 months after the completion of the fishing year. Provisional estimates of total catch and effort will be provided by 1 January, 6 months prior to the submission of detailed data.

- For surface fisheries monthly catch and effort data by 5 degree square will be provided for the 12 month period 1 July to 30 June, by 1 September of that year. Provisional estimates of total catch and effort will be provided by 1 July.

- Size composition data will be provided on a 5 degree latitude by 10 degree longitude by month basis at the same time as detailed catch and effort statistics are submitted.

Strategy for South Pacific Albacore Research

Consultations among scientists working on South Pacific albacore have identified a number of priority research areas they feel are critical for stock assessment and for evaluating fisheries interactions.

1. Tagging Studies.

Tagging has been identified as a useful technique for estimating vital population parameters and interaction among gear types. A cooperative tagging programme has been underway since 1986 by the U.S. and N.Z. This programme uses the same tags and tagging protocols and is coordinated by the SPC. In addition, SPC plans to expand this tagging programme in the STCZ in 1990/91, with three month-long tagging cruises aboard a combination pole-and-line and troll vessel. To date because of vessel availability, albacore tagging has been done from troll vessels. The use of a pole-and-line vessel is expected to increase the recovery rate of tagged fish.

Initially the highest priority will continue to be given to the release of the greatest number of tags to enhance prospects for recovery. Later plans may include the use of oxytetracycline and double tagging.

The objectives of tagging programmes for stock assessment and fisheries interaction studies may conflict. There is a continuing need therefore, to define the objectives and experimental design of tagging programmes as well as ensuring that specific tagging and fishing methods do not introduce bias.

2. Seasonality of spawning.

The possibility of semestral spawning in South Pacific albacore has been raised, based on growth rates obtained from analysis of daily otolith increments and the positioning of length-frequency modes in surface catches. Given the stock assessment implications of this tentative finding, it is important to determine the seasonality of spawning by way of sampling gonad indices. Onboard sampling of commercial longliners from Tonga and Fiji and from research longlining operations in New Caledonia, could provide a continuous time series of samples of known capture time and location. Fresh material thus collected could be used for microscopic examination to determine precise individual spawning times and periodicities.

In addition to gonad sampling, it may be desirable to initiate larval sampling in the presumed spawning areas in conjunction with existing programmes like TOGA and SURTROPAC.

3. Age and Growth Studies

There is an urgent need to corroborate growth increments using other methods.

The growth increments observed in otoliths and vertebrae have not been validated. The rapid growth indicated by analysis of otoliths may result from undercounting rings at the focus although there is general agreement between otolith counts of South Pacific albacore and validated increments in the North Pacific. SEM study of otoliths are being initiated by NMFS and comparison of otolith and vertebral growth increments from the same fish is planned between N.Z. and NMFS scientists. NMFS scientists have begun to analyze length frequency data to see if modal progression can corroborate growth rates inferred from hard parts.

4. Oceanography

Satellite sea surface temperature charts have been produced jointly by MAF Fisheries and the N.Z. Meteorological Service during the 1988/89 and 1989/90 albacore seasons to give a synoptic time series of sea surface temperature of fishing areas. These charts can also be used to interpret fishing success.

Subsurface temperature and salinity profiles using XBT's and some form of towed CTD data logger is also very desirable in a region as complex as the STCZ for studies of catch rate in relation to the STCZ and its associated fronts.

5. Scientific Observer Programme

The regular placement of scientific observers onboard commercial driftnet, troll, and longline vessels in the South Pacific is a high priority for future fishing seasons. The placement of observers is the only way to verify the catch and effort statistics upon which stock assessments depend. Observers are also ideally placed to provide catch composition estimates and size composition data of very high quality. In addition, observers can provide estimates of incidental mortality associated with fish dropping off hooks, dropping out of driftnets, and due to discards.

All these data will be needed for stock assessments.

SUMMARY OF SCIENTIFIC CONCERNS IN THE SOUTH PACIFIC

Scientists present at the First Consultation on a Regime for South Pacific Albacore Fisheries Management, held in Wellington in November 1989, provided a summary on the current state of knowledge of the South Pacific albacore stock. To reiterate, the major points highlighted at the Wellington Consultation were:

- "A longline fishery operating in the presence of a small surface fishery was estimated to have a maximum sustainable

yield (MSY) of 35,000 tonnes. When recent expansion of the surface fisheries began, the longline catch was close to its MSY level.

- The potential for increasing the total yield from the resource by increasing the harvest of juveniles in surface fisheries has been recognised. An initial development target of 10,000 tonnes for surface fisheries does not represent the MSY. The combined MSY for surface and longline fisheries cannot be estimated at present.

- Continuation of surface fishing at 1988/89 levels will reduce longline catch rates. The extent of the reduction is unknown.

- Uncontrolled and rapid expansion of the surface fishery is dangerous and poses a risk of overfishing the stock. Until the stock dynamics are better understood, the impacts cannot be quantified, nor is it possible to predict the time frame in which impacts may be clearly evidenced. Previous media reports of albacore stock collapse in two years are not based on assessments by scientists. This, however, does not lessen the concern expressed by scientists regarding the 1988/89 catch levels.

- Similarly, there are insufficient data available to thoroughly assess the driftnet fleet reductions [for the 1989/90 season] announced by Japan and Taiwan. Reduced surface catches will lessen impacts on the albacore stock and, therefore, on the longline fisheries, however, the effectiveness of these measures cannot be determined at this time."

There is concern regarding the threat large-scale pelagic driftnet fishing poses to the South Pacific albacore stock. There is also a need to immediately improve data collection and to direct future research to ensure we can conduct stock assessments and evaluate interactions between fisheries at the earliest time possible.

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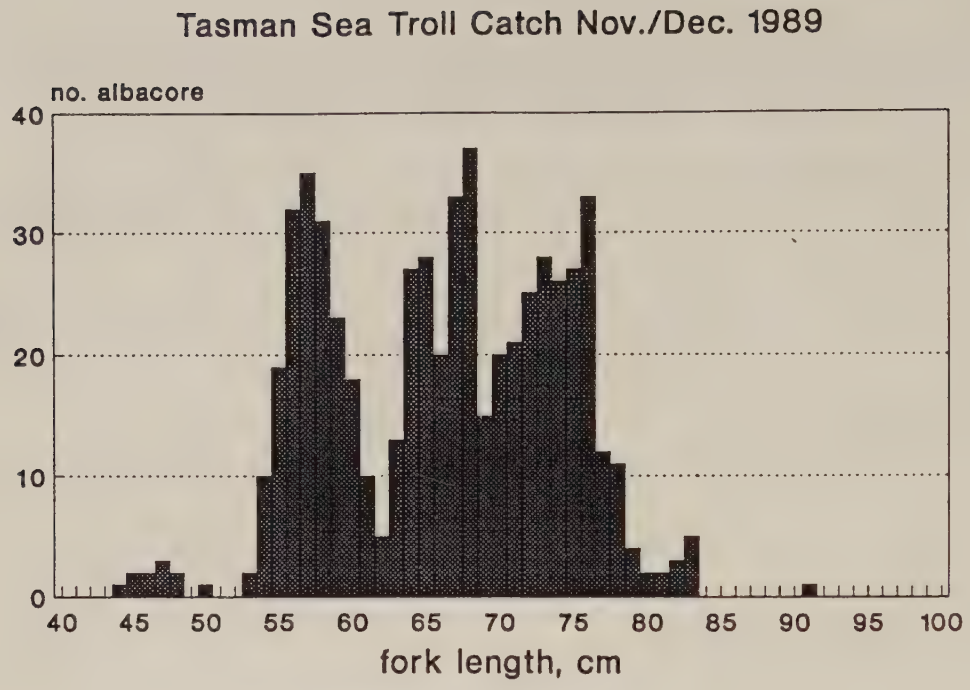


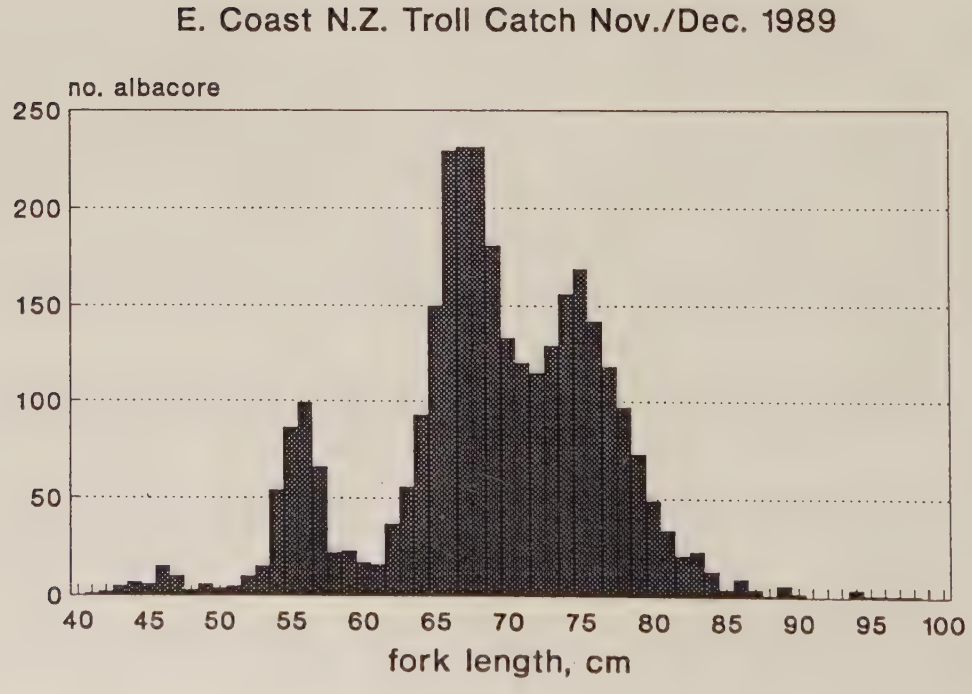
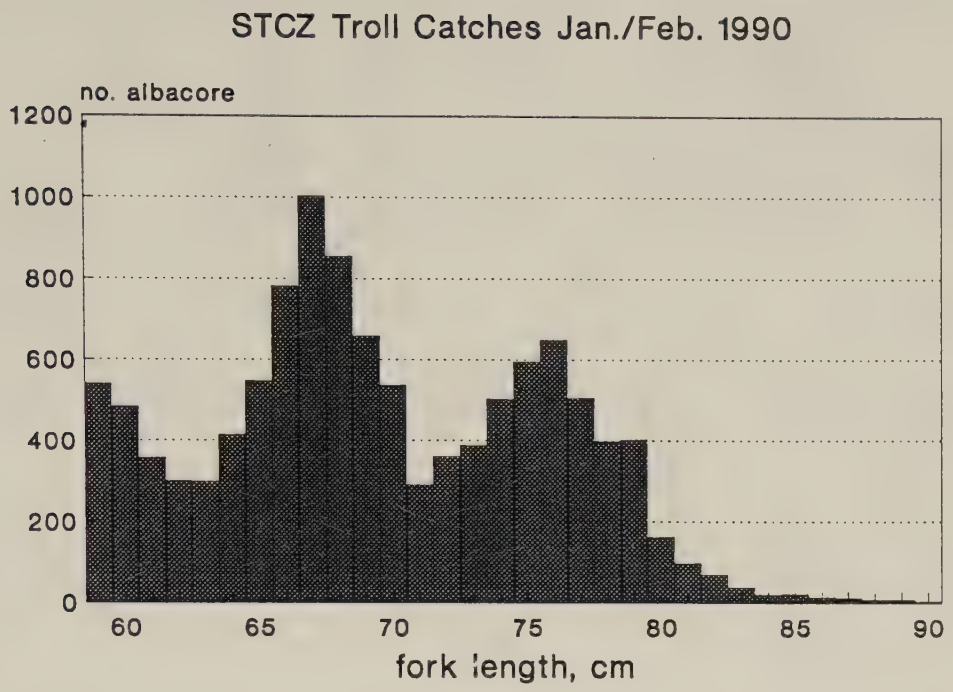


Figure 1 Length frequencies for troll caught albacore in the Tasman Sea (589 fish measured) and east coast of New Zealand (3106 fish measured).



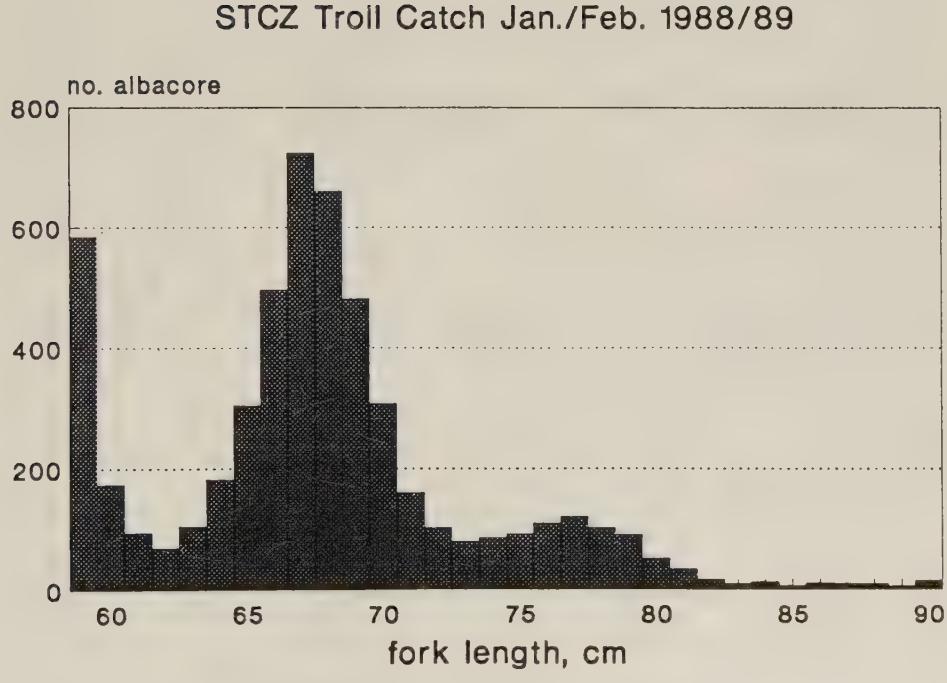


Figure 2 Length frequencies of troll caught albacore from the Subtropical Convergence Zone east of New Zealand in the January-February period of the 1988/89 (7096 fish measured) and the 1989/90 (12,364 fish). Approximately 8% of the fish measured were either smaller than 59 cm or larger than 90 cm and are not shown in the histograms.

APPENDIX J

Table summarizing information made available at the Consultation on the driftnet fleets in various regions of the world

HIGH SEAS DRIFTNET FISHERIES

Driftnet Fishery	Countries Fishing	No. of Vessels	Average Size	Mesh Size	Net Length	Commercial Target Species	Other Species Retained	Year Started	Main Season	Catch & Effort (Target Species): Most Recent Catch Figure	Source	Quality	Years Available	Logbook System	Comments	By-catch Species of Concern	Quantitative Data Available	Related Fisheries	Drop-out Rate	Regulatory Framework
North Pacific squid	Japan	463 (1988)	230 GT	120 mm	35-50K	flying squid id	albacore billfish albacore	1980 1981	Jun.-Dec. Jan.-Nov.	MT 158,000 (1988) 101,000 (1988) est.	log-book est.	good fair	1982-88 ?	yes yes	major observer program commenced (1989)	salmon cetaceans seabirds pinnipeds	R	salmon albacore troll, longline	2-5%?(R) ? ?	National licensing system limits vessel numbers/areas National licensing system limits areas of operation ?
	Korea	154 (1988)	200-300 GT	86-115 mm	35-50K	id														
	Taiwan	166 (1988)	?	?	35-50K		albacore billfish salmon	1980 ?		?	?	poor	?	no						
North Pacific salmon	Japan	212 (1989)	30-130 GT	110-130mm	35-50km	salmon	?	1952	Jun. July	10,000 (1989)	FSFRL	good	1952 to 1989	yes		cetaceans pinnipeds seabirds	R	salmon	?	Bilateral agreements -USA re observation/reporting · INPFC · National licensing
North Pacific large mesh	Japan	459 (1988)	100 - 500 GT	170 to 180 mm	35-50K	albacore	billfish other tunas sharks	1972	Jan. to May	5000 (albacore) 40,000 (total) N+S?	FSFRL	fair	1972 to 1988	yes 1989+	observer program for 1990	cetaceans seabirds? pinnipeds	N? N	troll, longline recrea-tional billfish	?	National licensing system
	Taiwan	?	?	?	?	"	"	?	?	6,000?	est.	poor	?	no				"	?	nil?
South Pacific large mesh	Japan	66-67 (1988-89)	500 GT	170 - 180mm	35-50K	albacore	billfish other tunas sharks? "	1975 1988	Dec-Mar. Dec. - Mar.	13,000 (1989) 18-39,000 (1989)	FSFRL est. est.	fair poor	1984-1988 -	yes 1990+ no		cetaceans seabirds? turtles? southern bluefin tuna	R	troll, longline recrea-tional billfish	7-9% visible on haul research cruise data	National licensing system nil? (Convention involving South Pacific nations but not DWFN's as yet)
	Taiwan	60-130 (1988-89)	?	180-210mm ?	35-50K ?															
	total fleet for 1989-90 ≤ 44 vessels																			
Indian Ocean large mesh	Taiwan	120 (1989)	?	180-210m?	?	albacore	billfish? other tunas, bigeye, skipjack, yellowfin sharks?	1985	Jan. to Aug.	14,000 (1988)	est. IPTP	poor	1985 - 1988	no		cetaceans? seabirds? southern bluefin tuna?	N N N	tuna longline southern bluefin tuna fisheries	?	nil?
North Atlantic tuna	France	37 (1989)	20m	170mm	6-7.5 Km	albacore	swordfish	1986	June-Oct.	4,000-4,500 (1989)	log-book	good	1986-87	yes		small cetaceans	R	troll, pole and line for albacore	3% visible on haul research cruise data	national licensing
Mediter-ranean	Italy	700-900	?	400-500mm 170mm	20-25KM	swordfish albacore	?	before 1980	Apr. to Oct.	10,000 (1989)	?	?	?	?		small and large cetaceans	?	longline	?	· GFCM to discuss · national licensing

R = Research/observer cruise data available

N = Nil/negligible

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